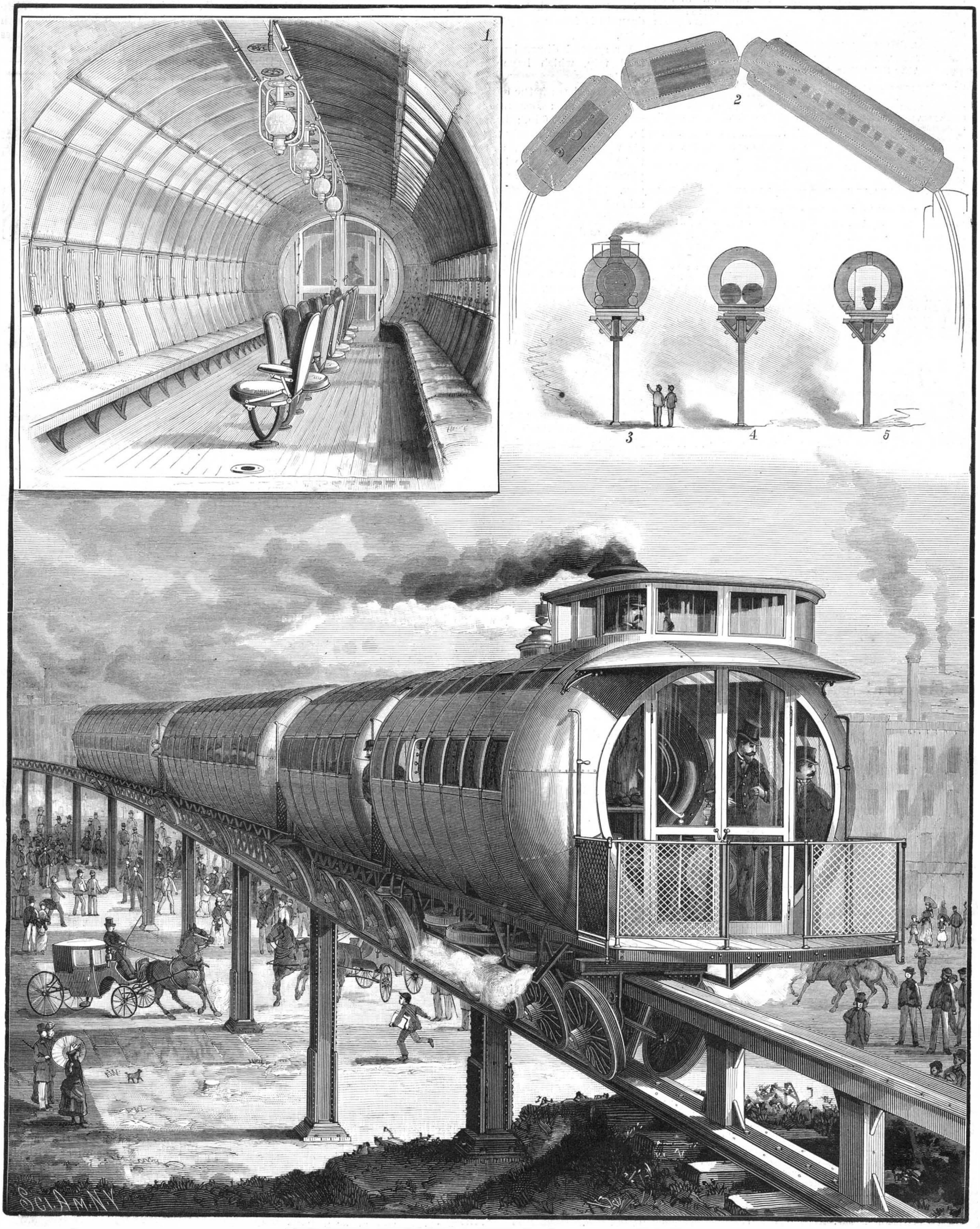
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LV.—No. 2. [NEW SERIES.] NEW YORK, JULY 10, 1886. [Price 10 Cents. $3.00 per Year.



THE MEIGS ELEVATED RAILWAY SYSTEM.—[See page 21.]

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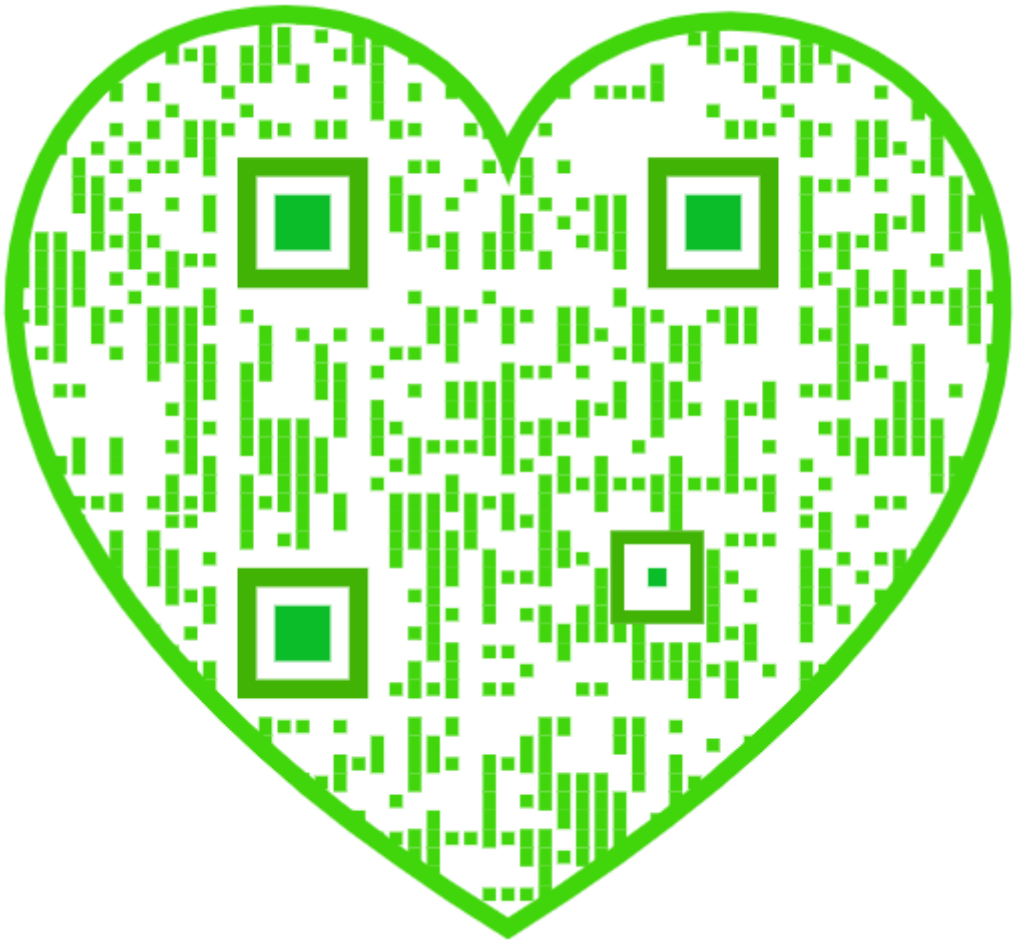

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

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NEW YORK, SATURDAY, JULY 10, 1886.

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THE FASTEST STEAM LAUNCH.

Henrietta is the name of a steam launch just built by the Herreshoff Manufacturing Company, of Bristol, R. I., for Norman L. Munro, of this city. She is elegantly built, principally of mahogany, and a large amount of polished bronze makes her very attractive to the eye. The most astonishing quality, though, is her speed, which is probably greater than ever before attained in a vessel of her size; and we may remark that in all the high speeds attained with other boats, the very best bituminous or semi-bituminous coals are used, that have only 3 to 5 per cent of ash, and to burn the coal fast enough inclosed stokeholds are used, into which air is forced with blowers. But the Henrietta uses anthracite coal of ordinary marketable quality, and the natural draught is increased by a small steam jet in the up-take.

We append dimensions of the boat and record of trial trip, which have been furnished us by her builders:

The Henrietta is the 133d steamer of our build. Her dimensions are: Length on deck, 48 ft.; length on water line, 46 ft. 6 in.; beam, 7 ft. 5 in.; depth, 3 ft. 9 in. She is open nearly two-thirds of her length; has air tight compartments at each end, and four water tight bulkheads. The hull is built of wood, and the planking, decks, etc., are double thickness of mahogany. The keel and entire frame is of white oak, and all fastenings are of copper and bronze.

Engine is of the triple expansion type, of our latest design, and intended for a very high steam pressure. The cylinders are 4 in., 6½ in., and 10 in. diameter, and the stroke of piston is 8 in.

Boiler is the "Herreshoff patent safety," and is of our usual improved type. It has about 9 sq. ft. of grate surface, and the draught is accelerated by a steam jet in the up-take. The fire and engine rooms are not inclosed.

Screw propeller is of bronze, with four blades, and is 28 in. diameter. The boat is almost entirely free from vibrations, even at the highest speed.

The trial for acceptance was made June 14. Six runs were made over a base of one mile (5,280 ft.) in Bristol Harbor. There was a moderate wind abeam, and the sea was quite smooth. A moderately hard red ash anthracite coal was used, that has about 15 per cent of ash.

Run.	Mean steam.	Time.	Speed.	Mean of pairs
1	244 lb.	3 m. 3 sec.	19·67	19·72
2	240 "	3 " 2 "	19·77	
3	244 "	2 " 59½ "	20·05	19·98
4	242 "	3 " ¾ "	19·91	
5	244½ "	2 " 59 "	20·11	20·165
6	250 "	2 " 58 "	20·22	

Mean speed, 19·955 miles = 17·3 knots.

Full time occupied, including turns, was between 24 and 25 minutes. There was no heating of bearings whatever, and it was the second time the boat had left the dock.

The Henrietta left Bristol for New York at 4:48 A.M., June 16, in a dense fog, having two persons only on board, the engineer and pilot. She was detained fully one hour by the fog, and was overtaken by the Stiletto, also bound to New York, off Horton's Point, L. I., at 12:15 P.M., just as the fog cleared away. She ran side and side with the Stiletto to Sands Point, and arrived under the Brooklyn Bridge at 6:15 P.M., having had head tide nearly all the way. The actual running speed was over 13 miles per hour; and if allowance be made for fog and adverse tide, her speed was nearly 15 miles per hour.

Consumption of coal from Bristol to New York, 900 pounds. Weight of the boat in running trim, 10,000 pounds. Immersed cross section, 7½ square feet nearly.

THE PNEUMATIC DYNAMITE GUN.

Lieut. Zalinski is still continuing his experiments with the pneumatic dynamite gun illustrated in the SCIENTIFIC AMERICAN of Oct. 31, 1885. The weapon is 60 feet long and has a bore of 8 inches, the projectile force being air under a pressure of 1,000 pounds to the square inch. The trials of the system made during the past fall were sufficiently successful to attract much interest in military and naval circles. The present experiments at Fort Lafayette, New York Harbor, have been witnessed by a number of officers specially appointed by the Secretary of the Navy. The target, consisting of a few sails rigged on a small scow, was placed at a distance of a mile. A number of barrels were anchored around it in a small circle of known radius. Ten blank projectiles were fired at the target. One passed through a sail, and all came sufficiently near the mark to have accomplished their purpose had actual warfare been in progress. Captain Howell, who is well known as an inventor himself, was one of the examining board, and expressed his confidence that these experiments have established the accuracy of the gun, but he was of the opinion that it could be still further improved. In additional experiments with loaded projectiles, one shell went to the bottom without exploding, but another, containing 58½ pounds of nitro-gelatine, burst just beneath the surface, and sent a column of spray into the air to a height of over 100 feet. When the gun was elevated 32 degrees, and the pressure of air at 1,000 pounds, the projectile was carried about two and a half miles.

The gun itself remains substantially the same as before, the present experiments being directed more particularly to the improvement of the projectile. In the latest form, the cylindrical shell is three feet in length, and in diameter the full size of the bore. The wooden tail piece projects several feet back of the cylinder, and is surrounded by spiral flanges of thin metal. In this manner the projectile is given a rotary motion similar to that of a rifle ball; and in consequence, greater accury and increased range have been obtained. The question of our coast defense gives particular interest to experiments with either aerial or submarine torpedoes, for the tendencies of modern warfare point to these as the probable weapons with which future battles are to be fought. It is understood that the board will continue to experiment with the pneumatic gun until thoroughly informed concerning its performance.

Chemistry without Apparatus.

When one is engaged in qualitative chemical analysis, it is necessary to change vessels at almost every reaction, or else be compelled to resort to frequent washing, which, if it be not properly performed, may spoil the results of the subsequent reaction. One of the best means that has been tried of getting over this difficulty consists in the use of the smoked capsules proposed by Mr. Violette. By smoked capsule is meant a small porcelain saucer covered with a layer of lampblack by putting it into the flame of a candle. A drop of water or of a saline solution, carefully deposited in this capsule, assumes therein the form of a globule, which is as limpid as crystal, and which does not adhere to the lampblack. The addition to this globule of another drop of saline solution or a particle of a solid reagent produces therein all the phenomena of coloration, precipitation, and crystallization with perfect clearness. The eye is capable of following in it the least changes (which are rendered still more manifest through the lenticular magnification) without having to look through the glass sides of what are usually used as receptacles.

After the phenomena has been observed, the globule is thrown out through a slight blow on the capsule. The latter will be found clean, without residuum, and perfectly fitted for the examination of another reaction without any mixture with the preceding. The vessel is, so to speak, clean without the necessity of cleaning it, and there need be no fear of any of those contaminations, even slight ones, that sometimes spoil analytical results in the ordinary vessels used.

The capsule, which is only three-quarters of an inch in diameter, is nothing else than one of those small porcelain saucers used for water colors. In order to put it into the flame, it must be grasped with pincers; but the operation may be more easily performed by gluing a thin cork disk to it, and sticking a pin into this for a handle. For smoking one of these capsules properly it is necessary to use precaution. It should be thrust into the upper third of the flame of a candle several times, and be allowed to cool in the intervals. It is necessary to wait until the capsule is cold before depositing the globule in it, for otherwise it would get wet. The carbonaceous coating is at once made wet by acid, alcoholic, and ethereal liquids, and it is only aqueous solutions that assume a globular form upon it.

This mode of operating may be still further simplified by taking advantage of the property that the leaves of the same plants possess of not being wet by water and aqueous saline solutions. Among such leaves those of the nasturtium (*Tropæolum*) have a form that especially adapts them to this use. When one of these is held by its petiole, its upper surface exhibits a depression in which one can easily deposit a globule, and proceed exactly as with the smoked capsule. When the leaf becomes wet, after a few reactions, nothing is easier than to substitute another one for it.—*La Nature.*

The Radiophone.

M. Mercadier has devised a radiophone of a very simple kind. It is in fact simply a microphone with the supports of the carbons fixed to a thin diaphragm or plate of varnished pine. The microphone is connected to a magneto receiver with or without induction coil and in circuit with a battery. In exposing the diaphragm to the action of intense radiation, rendered intermittent by a revolving wheel or screen pierced with holes, the telephone gives out a note corresponding to the oscillations of the radiant energy. Further, a telephone transmitter with its iron diaphragm to the radiation gives out a corresponding note in the receiver. The effects are increased by smoking the diaphragm, or using a powerful source of light, such as the oxyhydrogen or arc light.

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PHOTOGRAPHIC NOTES.

Correct Color-Tone Photography with Ordinary Gelatine Bromide Plates.—In a recent communication read before the Franklin Institute at Philadelphia, from advance sheets of the *Journal of the Franklin Institute*, Mr. Fred. E. Ives relates the following concerning some interesting experiments with color screens, intended to be located in the camera, behind the lens:

Chlorophyl-stained collodion bromide emulsion plates have been made four or five times more sensitive to spectrum red than to blue. It has been estimated that ordinary gelatine bromide plates are one hundred times more sensitive to blue than to red. The *relative* red sensitiveness of the chlorophyl-stained collodion plates is, therefore, probably four hundred or five hundred times greater than that of ordinary gelatine bromide plates. But the most rapid ordinary gelatine bromide plates are one hundred times more sensitive to ordinary diffused daylight than the collodion emulsion plates, and it would, therefore, appear that the absolute red sensitiveness of the very rapid gelatine plate should be one-fifth as great as that of the very slow chlorophyl plate. By recent experiment in photographing the lime-light spectrum, I have found this estimate to be very nearly correct for some makes of extra rapid gelatine bromide plates.

What, then, is to prevent us from making correct color-tone photographs with very rapid ordinary gelatine dry plates? The difficulties, although apparently great, are not insurmountable, as I shall show; but the exposures are necessarily so long that the method is not available in many cases where the regular isochromatic processes can be successfully employed. I have calculated that, in order to secure correct color-tone without a color-screen, it would be necessary to have plates about ten times as sensitive to spectrum red as to blue; if this estimate is correct, the ordinary rapid gelatine dry plate is relatively one thousand times too sensitive to blue; and in order to secure correct color-tone with such a plate, it would be necessary to cut off $\frac{999}{1000}$ of the blue light, and green and yellow in due proportion. It is very easy to cut off a large portion, or all, of the blue light, but it required a great deal of patient experiment to produce a color-screen that cut off just enough of the blue, and also of the green and yellow. I accomplished this by a mixture of aniline color solutions in the plate-glass tank which I recommended for color-screen purposes in 1879. My first trial exposures were made on the lime-light spectrum. I commenced by adding aniline yellow to water in the tank, a little at a time, until so little blue light was transmitted that it produced very much less action than the red; I then added aniline red until the green acted but little more than the blue, and aniline violet to slightly reduce the action of the yellow. An exposure made in the camera, using this color-screen and a M. A. seed plate, proved that my calculations were very nearly correct. I was only obliged to add a little more yellow and red to the color solution to secure correct color-tone in all the colors of a bright chromo, which I use as a test object. *With exposures five times longer*, I have secured results apparently equal to those obtained with my chlorophyl-eosine plates and yellow screen.

The result which I obtained cannot be even approximated by means of a screen of any single-color solution that has been tried, and I believe this to be the first specification of the production of a color-screen actually capable of securing correct color-tone with ordinary plates.

Purple-Brown Stains in Gelatine Bromide Prints.—We recently had bromide paper prints shown to us for examination which had on their surface irregular-shaped stains, varying in size from one inch wide to half an inch by from two to four inches long, of a peculiar purplish brown tint. The operator had used the best of care, having followed the printed instructions to the letter, but was troubled now and then with the stains. We ascertained by experiment that the sole cause of the stains was due to the injection, either from the fingers or accidentally, of an infinitesimal amount of hypo. into the water or vessel in which the sheet was dipped prior to development.

It is well known that any trace of hypo. on the fingers coming in contact with a corner of a bromide sheet will cause the corner to immediately blacken when immersed in the ferrous oxalate developer.

This same reaction occurs, only much slower, when the amount of hypo. present is still less, resulting in the formation of the peculiar stain spoken of. In working gelatine bromide prints, it is very necessary that no trace of hypo. be upon the fingers or in the dish of water in which the prints are first wetted.

AN explosion of nitro-glycerine occurred July 2, in the mixing house of a dynamite factory at McCainsville, N. J., whereby ten men lost their lives. Only little bits of their bodies were afterward found, the woodwork of the house was mostly reduced to fine powder, and small craters in the earth marked points where most of the nitro-glycerine is supposed to have been.

James Muspratt.

James Muspratt, the founder of the alkali industry, died at Widnes, Eng., May 4, at the age of 93 years. He was born in Dublin, August 12, 1793. At 14 years he was apprenticed to a wholesale druggist and apothecary, where he acquired some practical knowledge of chemistry. With a small capital he commenced the manufacture of acetic and hydrochloric acids and other chemicals, and some time afterward, in partnership with a Mr. Abbott, that of prussiate of potash. In 1822, dissolving the partnership, he removed his plant to Liverpool, where he began the erection of lead chambers for the manufacture of sulphuric acid, with the intention to practically work out the Leblanc process of manufacturing soda. His Liverpool works soon becoming inadequate to the demand, he erected more extensive works, in partnership with Mr. Gamble, at St. Helena. Expelled from both places by expensive lawsuits for damages, he went to Flint and afterward started works at Widnes, where about 350 men are employed under the direction of his son, Mr. E. K. Muspratt, in the manufacture of soda ash, sulphate of soda, bleaching powder, caustic soda, sulphur, brown vitriol, rectified vitriol, chlorate of potash, hydrochloric acid, and chloride of magnesia.

Weights and Strength of Girders.

In the large tubes of the Britannia bridge, the weight of the top and bottom flanges is nearly equal, while the sides are a little more than one-third the whole weight, viz., 37 per cent. From these considerations, it is very easy to arrive at a quick method of estimating the weight of any given girder. The sectional area at the center of one flange being obtained, the weight per foot is known; one-fourth of this, at least, may be saved by proper arrangement of the materials, and the weight of the whole beam will be three times this result. The Board of Trade limit the strain on wrought iron to 4 tons to the square inch in compression and 5 tons in tension. This would make the bottom flanges of beams lighter than the top, were it not for the weakening effects of rivet holes; it is therefore generally correct to make the bottom flange the same gross area as the top. By dividing the strain in tons in the center of a flange by 4, we obtain the sectional area; multiplying this by $3\frac{1}{3}$ pounds, the weight of an inch square bar a foot long, we obtain the weight per foot of the flange; multiplying this into 3, we obtain the weight per foot of the beam, supposing its sections to be uniform; and finally, multiplying by $\frac{3}{4}$, we get the average weight of a beam, the flanges and lattices of which are proportioned in some degree to the varying strains. If we assume the depth of a beam to be 1 foot in 12·8 feet, a very good proportion, this formula becomes

$$\text{Weight per foot } \frac{W \times 12{\cdot}8 \times 3\frac{1}{3} \times 3 \times 3}{8 \times 1 \times 4 \times 4} = 3W.$$

Or, in other words, multiply the distributed load in tons a beam is required to carry by 3, and the result is the weight in pounds per foot of the beam.—*The Architect.*

Efficiency of Small Water Motors.

Nowadays, when so many of the small cities throughout the country are supplying themselves with water works, it seem time to notice a class of small motors in which the water pressure can be utilized to develop power for driving such various kinds of machinery as are usually operated by hand. Sewing machines for clothing and dressmaking establishments and private houses; small lathes and drills for light manufacturing purposes and repair shops; in groceries for roasting and grinding coffee; in restaurants and dining rooms for actuating fans for ventilation and fly screens; and in barber shops for revolving hair brushes, and so on through a long list of uses for saving hand labor.

Some of these take the form of water engines, especially when adapted to blowing organs, or producing a reciprocating motion. Others are models of turbine wheels, while many of these motors are simple forms of impact and reaction wheels, wherein the power is derived from the direct impinging of a small jet of water at a high velocity against a series of cupped floats or plates attached to the arms of a wheel inclosed in a case, the waste water flowing off to the sewer after having spent its force in causing the wheel to revolve.

Such a motor is very simple in construction, and consists of a wheel with the series of floats attached on its periphery, inclosed in a chamber to prevent the dashing of the water; and as this revolves in the case without contact, the only parts liable to wear are the two journals of the supporting shaft, which, projecting through the sides of the chamber, are provided with oil boxes and are easily cared for. These ends of the shaft are fitted with pulleys, from which motion is communicated to a line shaft by belting or cord. A very pretty application shown in a grocer's window was one of these motors. The shaft on one side was provided with a pulley, from which was driven a set of coffee grinders, while from a crank attached to the opposite end a connecting rod worked a machine for slicing smoked or dried beef.

The motors are very handy. They are always ready when their services are required for either long or short duty, and they never get tired. A moment given to open the water valve, and they are in motion. Simply closing the same valve, and they are motionless, and while at rest they are no expense. In this respect they have the advantage of both steam and hot air engines, which require the continual keeping up of the steam pressure in the boiler or of heat in the furnace, and also of gas motors, which are much more complicated pieces of mechanism, and require better mechanical skill and ability in their attention and care.

In fact, they are, because of their extreme simplicity and non-liability to get out of order and wear out, peculiarly adapted to fill the demand for help where a constant water pressure and supply can be obtained.

In regard to the expense of operating such motors, that of course depends upon the total hours per day they are run and the load they are called upon to carry. In their proportion of parts, the nozzle from which the water issues for discharge against the floats will range from one-eighth to one-fourth inch diameter; the size will depend upon the working head or water pressure in connection with the amount of power required. The greater the pressure the smaller the nozzle, and less water required to develop the power.

Take, for instance, a motor having a nozzle of three-sixteenths of an inch diameter with a working head of 60 feet. The maximum theoretical discharge from an orifice of three-sixteenths inch diameter under a head of 60 feet would equal 44·68 pounds of water with a velocity of 37·29 feet per minute. Allowing for the friction of vent, the actual effective discharge would be reduced to, say, 32 pounds of water delivered per minute. $32 \text{ lb.} \times 37{\cdot}29 \text{ feet per minute} = \frac{119{\cdot}328}{33{\cdot}000} = 3{\cdot}3$ horse power; deducting from this 40 per cent for loss of efficiency, and it leaves, say, two horse power as the maximum practical effect from the use of 32 pounds of water per minute, or $\frac{32}{2} = 16$ pounds of water $\times$ 60 = 960 pounds per hour; $960 \times 10 \text{ hours} = \frac{9{,}600}{625} = 153\frac{6}{10}$ cubic feet per day; 153·6 × 300 working days = 46,080 cubic feet per year. 46,080 cubic feet × 2 mills per cubic foot will amount to 92·16 dollars per year for the water to produce an average of one horse power per hour. That would be for constant power for ten working hours and three hundred working days. In case the motor was at work only part of the time, then the expense would be only in proportion to the hours run, while if the pressure was double and the cost per cubic foot remained the same, then the expense would be less, and so on.—*American Engineer.*

Health in Connecticut.

The May report of the State Board of Health for Connecticut says:

In nine cities, representing a population of 276,000, or about three-eighths of the population of the whole State, the death rate was 14·02 to the 1,000 people, as compared with 18·9 in the month of April in the same cities. So far as this estimate may stand for the general health of Connecticut, it shows a very gratifying improvement over the health of the preceding month.

While about the same list of fatal diseases are reported from the various towns, the marked diminution in their fatality is to be noticed. The most fatal diseases in April were consumption and pneumonia.

In April there were 74 fatal cases of consumption in the above nine cities, but in May only 60. In April there were 73 fatal cases of pneumonia in the same; but in May only 18.

How much a general improved state of health is to be attributed directly to warmer weather, and how much indirectly to the escape from the confined and unwholesome air of houses, which warmer weather permits, is a very difficult question to solve.

The open air, free and pure, is an acknowledged essential of health. House air is often foul and even poisoned. There is much reason to think that open doors and windows, which warm weather allows, has more to do with diminished sickness than a merely higher temperature.

For Staining Bricks.

For staining bricks red, melt one ounce of glue in one gallon of water; add a piece of alum the size of an egg, then one-half pound Venetian red and one pound of Spanish brown. Try the color on the bricks before using, and change light or dark with the red or brown, using a yellow mineral for buff. For coloring black, heat asphaltum to a fluid state, and moderately heat the surface of the bricks and dip them. Or make a hot mixture of linseed oil and asphalt; heat the bricks and dip them. Tar and asphalt are also used for the same purpose. It is important that the bricks be sufficiently hot, and be held in the mixture to absorb the color to the depth of one-sixteenth of an inch.

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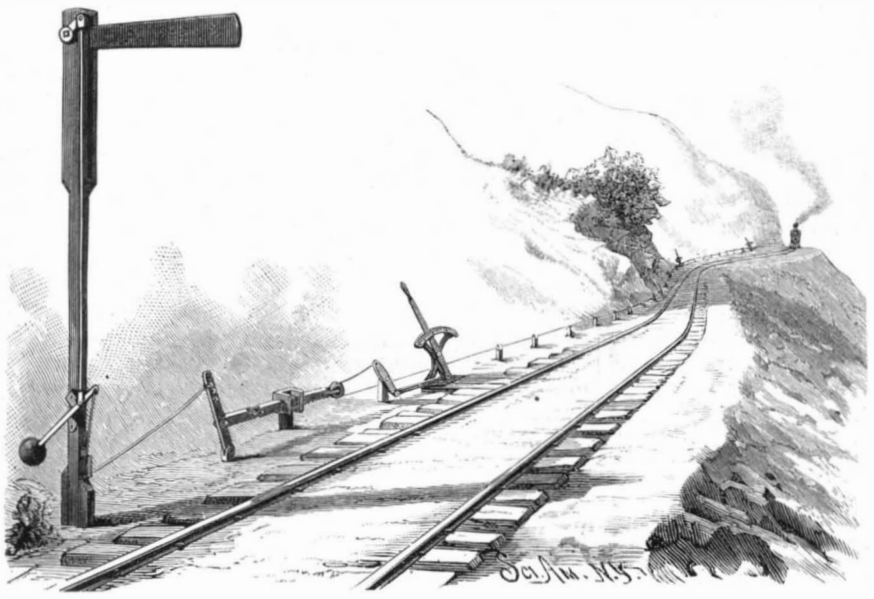
Novel Way of Advertising.

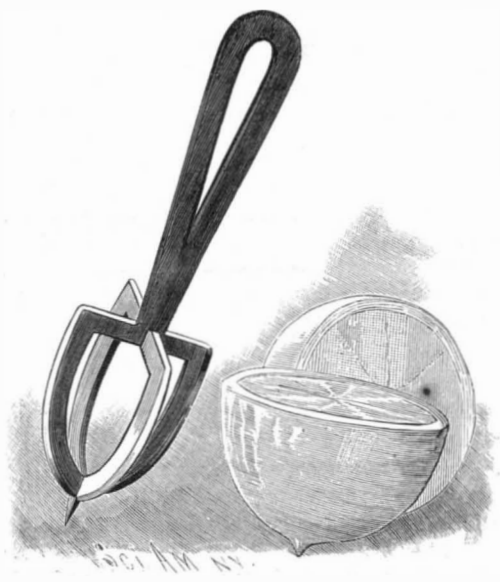
A lady going north a few days ago, says a Chicago newspaper, was stopped by a rather shabbily dressed woman, who inquired where Schultz's dye house was. "I do not know," was the reply. "Well, why don't you know? It's over corner Illinois and Clark Streets," was the apparently disgusted reply. Subsequent developments proved that this has become a new mode of advertising. It is indeed a novel one, and one that certainly leaves an impression on the person questioned



MARTIN'S OPERATING MECHANISM FOR RAILWAY SIGNALS.

FRUIT PULPER.

The object of this invention, which has been patented by Mr. Frank W. Bradley, whose address is P. O. Box 2,015, Denver, Col., is to provide a simple implement for easily removing the pulp from lemons, oranges, and similar fruit. The curved blades are united at the bottom and form a point, and their opposite ends are connected by arms with the handle. The curvature of the blades is approximately the same as that of the inside of the peel of a lemon or orange, so that when the pulper is inserted in the pulp of one-half of the fruit, and turned, it will remove the pulp without its being flavored with the oil of the peel. The blades may be made detachable from the handle, if desirable.



BRADLEY'S FRUIT PULPER.

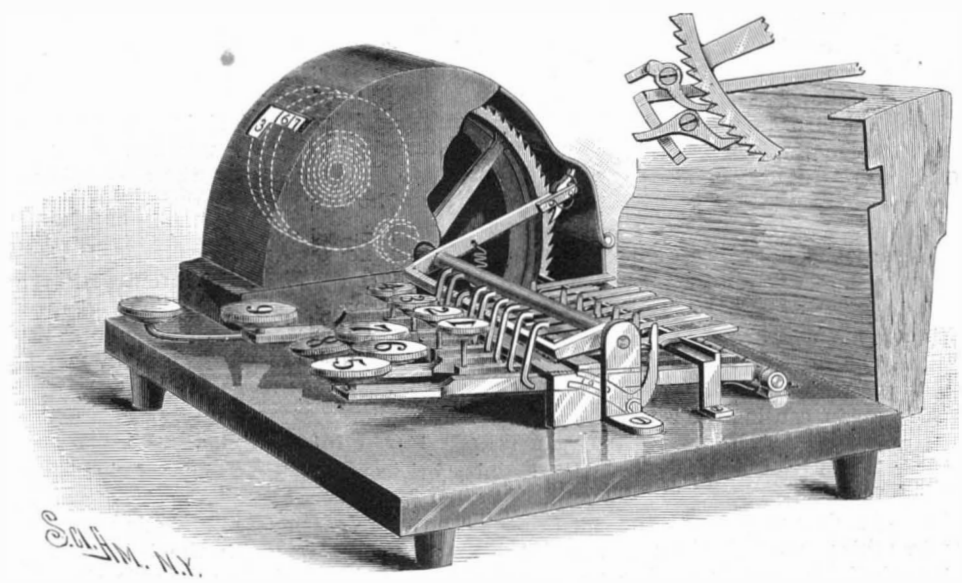
OPERATING MECHANISM FOR RAILWAY SIGNALS.

By means of the construction herewith illustrated, a single signal can be operated by a single line wire from any number of points desired, but which, having once been set to "danger" from one or more of the stations, cannot be set to open the line until all of the signal stands have been moved to "safety." In the ordinary forms of construction heretofore in use, the signal has been operated by a wire direct from the signal stand; but by this invention there may be interposed as many different signal stands as desired, at such distances apart as may be most convenient, one of these interposed signal stands, as shown in the illustration, consisting of a lever pivotally mounted on a standard, and connected by a pitman with the short arm of another lever, through which the pull of the wire is transmitted to a sliding bar, riding in slots, and thence through another pivotal lever to the signal. At each of the stands there are racks with limit pins or stops to prevent the passage of the lever arms; and the upper arm of the lever, to which is attached the wire communicating directly with the signal, has several holes, the throw of the lever being determined by attaching the wire at a proper distance from the fulcrum. When the lever is released at any one of the signal stands, it permits the levers to change and the wire to slack from such point sufficient to drop the weight at the signal post. As the weight falls, it displays the danger signal, the full rise of which is easily insured by the compensating lever. After the line has thus been closed by the setting of the danger signal, it cannot be again opened until all the parties who have given the danger signal set the levers at their respective signal stands for safety. By such an arrangement of operating mechanism, it is claimed that the number of distinct signals required for a section of road can be greatly reduced, and thus effect a saving that will be readily appreciated by railroad men.

This invention has been patented by Mr. Peter N. Martin, of Madalin, N. Y., to whom, or to Mr. Miller Longbottom, of No. 7 Fulton Fish Market, New York city, should be addressed all communications relative thereto.

ADDING MACHINE.

In the machine herewith illustrated there are nine levers, each provided at its outer end with a disk marked with a numeral. When one of the levers is depressed, a pawl carried upon the end of an arm passes up over as many teeth of a ratchet wheel as are indicated by the numeral of that particular key; the arm carrying the pawl is then drawn down by a spiral spring and turns the wheel, which is held from being turned back by the friction of the pawl by a second pawl pivoted to the bed plate. The wheel is loosely mounted upon the end of a shaft extending across the bed plate and journaled in suitable standards. There are one hundred teeth formed upon the wheel, and upon its rim is formed an annular flange marked with numerals from 1 to 100. To the outer end of the hub of the wheel is attached a small pinion wheel, with which meshes a gear wheel having a rim marked with numbers 1, 2, 3, and so on, as many division marks being used as the teeth of the gear wheel are multiples of the teeth of the pinion, so that this rim will indicate the number of revolutions of the ratchet wheel, and consequently the number of hundreds in the sum. With the journal of the gear wheel is connected the end of a spring, so arranged as to be coiled up by the forward revolution of the wheel, and having sufficient strength to turn the ratchet wheel and gear wheel back to the zero points when the pawls are raised, which is accomplished by depressing the lever having a blank disk. The mechanism is covered by a casing having apertures over the zero marks of the wheels, in order that the sum can be readily read. In using the machine, the keys representing the figures to be added are successively depressed, and the sum of the column of figures can be read through the apertures.

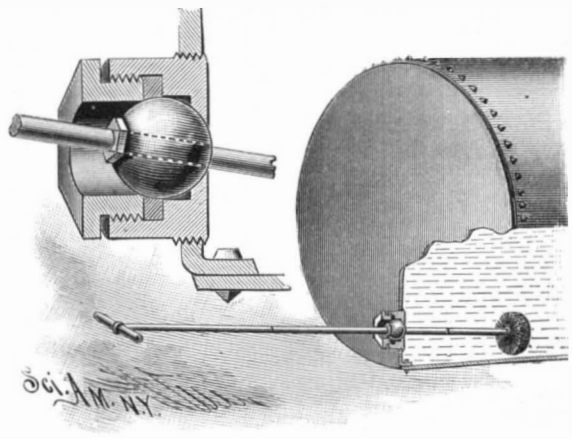


LINDHOLM'S ADDING MACHINE.

This invention has been patented by Mr. Peter L. Lindholm. Further particulars can be had by addressing Messrs. Lindholm & Peterson, of Franconia, Minn.

BOILER SWEEPER.

A sweeper for cleaning scales and sediment from boilers, tanks, and stills, that can be used while the pressure is on, is shown in the annexed engraving. In the head of the boiler, and as near the bottom as possible, is screwed a pivotal universal joint connection for the sweeper rod. The construction of the connection is clearly shown in the sectional view. The sweeper rod is made in sections screwed together to allow of its being drawn out and disconnected to prevent corrosion.



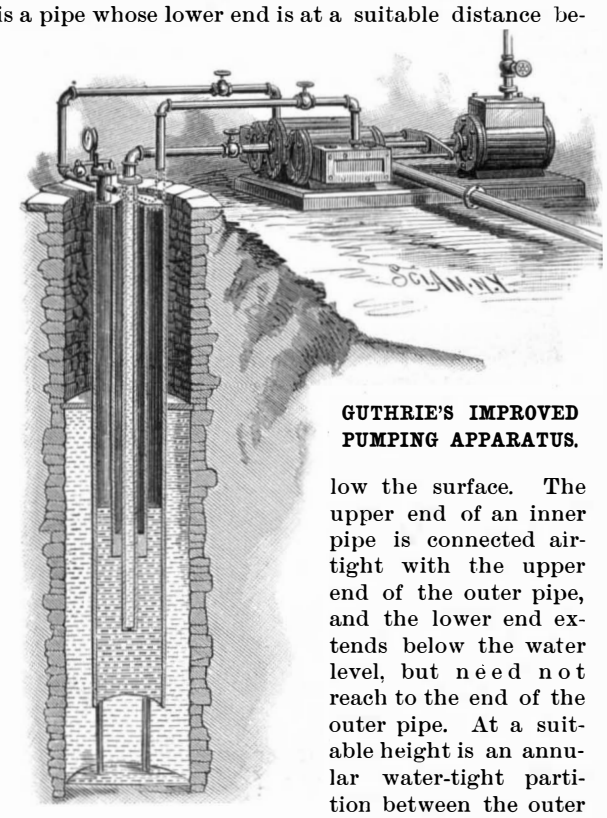
LEVI'S BOILER SWEEPER.

The last section remains in the ball, with the brush drawn up so as not to rest on the bottom and endanger its burning, and this section is made as short as possible, to prevent it projecting too far at the front of the head. With this device every portion of the bottom of the boiler can be reached and cleaned by the brush, and this sweeping operation can be performed when the boiler is under pressure, so there need be no loss of time.

This invention has been patented by Mr. William T. Levi, of Charleston, W. Va.

IMPROVED PUMPING APPARATUS.

Extending into the well, cistern, or other reservoir, is a pipe whose lower end is at a suitable distance below the surface. The upper end of an inner pipe is connected air-tight with the upper end of the outer pipe, and the lower end extends below the water level, but need not reach to the end of the outer pipe. At a suitable height is an annular water-tight partition between the outer pipe and the wall or casing of the reservoir. Connected air and water tight with the lower end of the second pipe is a third one; between the second and third pipes is an air space to prevent the second pipe from being crushed by the air pressure in the outer pipe when a vacuum is formed in the third or inner pipe, whose upper end is connected with a pump cylinder as shown. To the main piston rod is attached a cross-bar, to the ends of which are secured piston rods of two cylinders, placed at opposite sides of the pump cylinder, so that the suction pump and the two air force pumps at the sides will be operated from a common piston rod. The air chambers of the air pumps are connected with the air-tight cover uniting the upper ends of the first and second pipes. The connecting pipes are provided with proper valves. When the engine is operated, the liquid is drawn by the pump and forced through a discharge pipe, while



GUTHRIE'S IMPROVED PUMPING APPARATUS.

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air is forced by the pumps into the outer pipe and compressed therein, so as to apply the compressed air to the surface of the liquid in the outer pipe, and thereby assist in forcing it into the suction pipe. With this apparatus, water can be easily raised to any desired height.

This invention has been patented by Mr. Patrick F. Guthrie, of Franklin, N. J.

POLARIZED LIGHT.

A FEW OBJECTS FOR THE POLARISCOPE.

BY GEO. M. HOPKINS.

II.

Scientific experimentation, though practiced merely as a pastime, can but elevate the thoughts and bring the mind into new channels, thus promoting knowledge to some degree, even though the student proceed no farther than the observation of effects. But once interested in effects, the inquisitive mind cannot rest satisfied without probing for causes.

So far as effects are concerned, the subject under consideration is everything that could be desired, and no great scientific knowledge or high manipulative skill is required to secure splendid results.

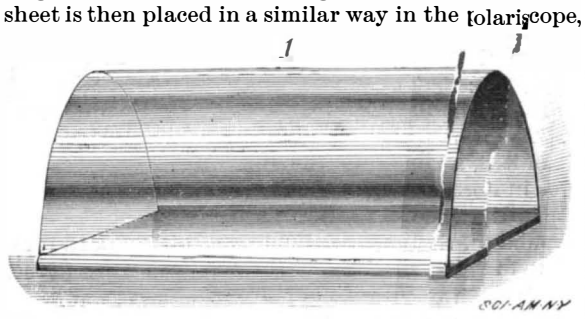
In a former article, the writer mentioned a few ways in which light could be polarized and analyzed, and gave hints as to some objects which might be viewed by polarized light.

A few simple objects easily prepared from mica are here shown. The material is of course procurable everywhere, and it requires little more than a glance at the engravings to enable any one to prepare the objects. Doubtless many other forms than those illustrated will suggest themselves to the student.

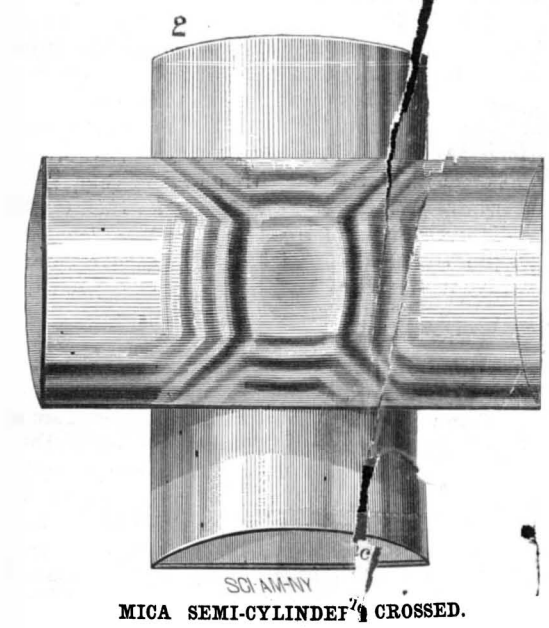
The simplest form is shown in Fig. 1. It consists of a thin plate of mica bowed into approximately a cylindrical form, and secured by its edges to a plate of glass by means of narrow strips of gummed paper. The size is immaterial; the glass plate may be 1½ inches wide by 3 inches long. This object exhibits fine bands of prismatic color when viewed in the polariscope. Two such semi-cylinders, when crossed, exhibit the intricate figure shown in Fig. 2, with all the splendid colors of the spectrum.

The object shown in Fig. 3 is formed of a disk of mica having a sector cut out and the radial edges overlapped, forming a low cone. The overlapping edges are best fastened together by small tin clips inserted in holes in the mica and bent downward on opposite sides. The clips are not noticeable, and are efficient in holding the edges together. Cement will not answer the purpose, as it adheres to the surface only, and it must be remembered that mica splits almost indefinitely.

The cone thus made has the appearance in the polariscope of a huge circular crystal of salicine. The colors of the cone may be heightened by mounting it on a sheet of mica, as shown in the engraving. The cone is first placed in the polariscope, with the polarizer and analyzer crossed, and turned until it appears brightest, when the lower edge is marked. The mica sheet is then placed in a similar way in the polariscope,



MICA SEMI-CYLINDER.

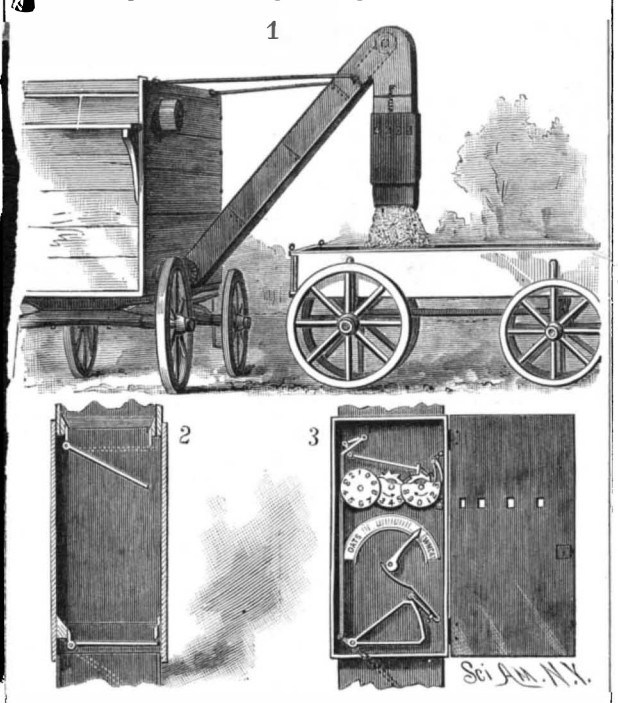


MICA SEMI-CYLINDERS CROSSED.

and turned and marked. The cone is then cemented by its edges to the sheet, the marked edges of both members being arranged in the same direction.

The Maltese cross shown in Fig. 4 is revoluble. The first step toward the preparation of this object is to secure a pin head downward on a square of glass with sealing wax or other cement. A small paper tube which will fit the pin loosely is then made, and a little head of sealing wax is formed around the tube near one end. A piece of mica is selected which exhibits fine colors in the polariscope, and four equilateral triangles are cut from it, either with their corresponding sides cut upon the same base line, or with one side of each cut from one side of a square, or they may be cut and mounted haphazard.

To the apex of the angle designed for attachment to



GABBEY'S AUTOMATIC GRAIN WEIGHING AND REGISTERING MACHINE.

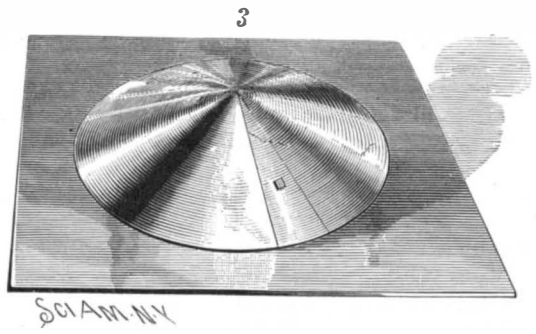
the paper tube a small drop of sealing wax is applied, and with the tube on the pin the first triangle is attached by holding it in the required position by means of a pair of tweezers, and then fusing the wax on the mica and that on the tube simultaneously by means of a small heated wire, such as a knitting needle.

The other members are placed and secured in a similar way, care being taken to arrange the triangles symmetrically, and at a slight angle with the plane of rotation of the object, as shown in the engraving.

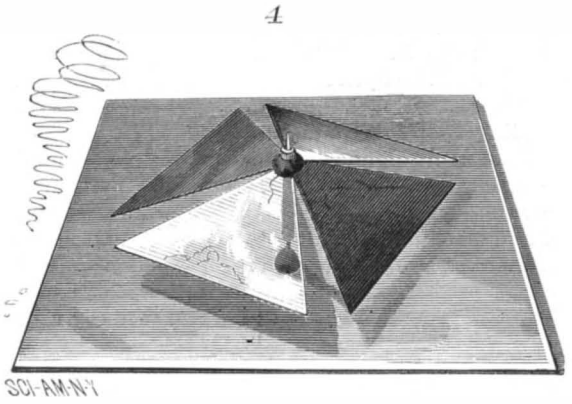
The wheel shown in Fig. 5 and the star shown in Fig. 6 are prepared in a similar way. The sections of the wheel are cut from a circular piece of mica, and cemented in place on the paper tube after the fashion of a propeller wheel or wind wheel.

Each ray of the star is made of two scalene triangles of mica oppositely arranged with respect to each other, and inclined in opposite directions, the longer and shorter sides of adjacent triangles being fastened at the periphery of the star by a minute drop of sealing wax.

In Fig. 6 beside the star are shown two somewhat similar objects, formed of strips of mica, pivoted together on a small rivet, one object having the pivot in the center of the strips, the other having it at the



MICA CONE.



end, giving the object an appearance similar to that of a folding fan.

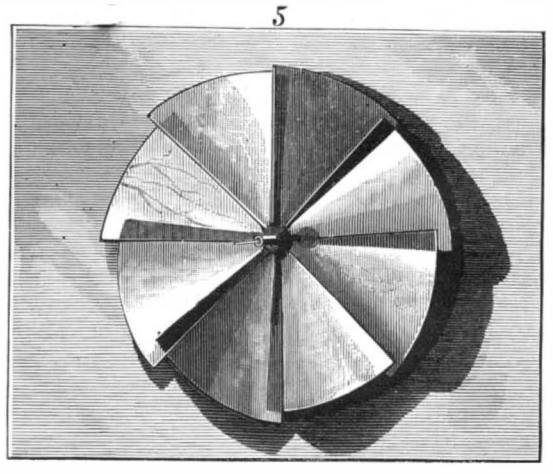
Any of these objects may be viewed by means of the black glass polarizer in connection with either of the forms of analyzer described in the former article, or in the simple form of Norremberg doubler. These objects are also very satisfactory when projected on the screen.

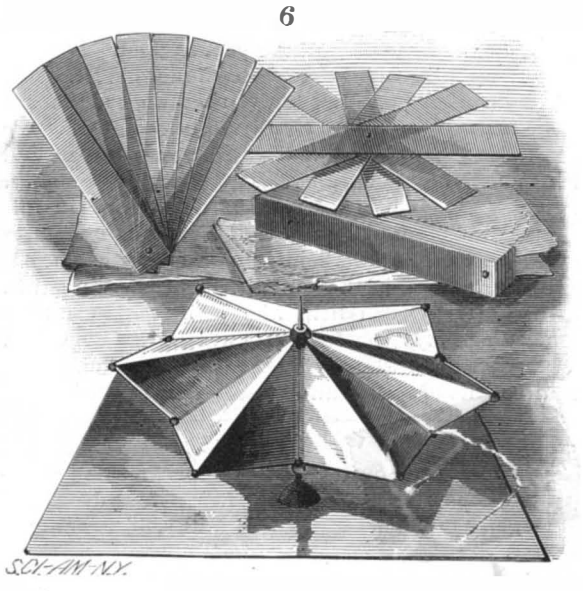
AUTOMATIC GRAIN WEIGHING AND REGISTERING MACHINE.

This machine is designed especially for attachment to the elevator spouts of grain separators and corn shellers. The case is made in three parts—a large central part and two smaller end ones. In the upper and lower ends of the central part are placed plate valves. The upper valve closes against the sharp beveled edge of a metal strap designed to cut off straws, weeds, and other substances that would prevent the valve from closing tightly. The lower valve closes against the lower edge of a metal strap, the upper parts of which are bent upward and outward and are attached to the inner surface of the end of the central part. The valves are so connected that one will always be closed when the other is open. Attached to the shaft carrying the upper valve is an arm pivoted to the rear end of a pawl operating numbered wheels (Fig. 3). With this construction, as the valve is lowered to admit grain to the central part of the case, which is designed to contain half a bushel, the pawl is drawn back, and when the valve is raised to stop the inflow of grain, the pawl is pushed forward to make the numbered disks register the amount. At the proper time the numeral ½ can be seen through one of the holes in the door covering the register. To the shaft of the lower valve is rigidly attached the acute angle of a triangular arm, whose outer angles are cut off to form seats for a friction roller pivoted to the end of the short arm of a spring attached to the frame.

The long arm of the spring rests against a pivoted eccentric provided with an index finger, which points to a scale marked with the names of the different grains to be cleaned and weighed, and the number of pounds of each to a bushel. The tension of the spring is regulated by adjusting the finger so that the spring will hold the arm with sufficient force to keep the valve closed until the weight of half a bushel of grain has been received upon it, when it will open to discharge the grain, and the upper valve will close to prevent any grain from entering the middle part of the case while the lower valve is open. The case is suspended from the spout of the elevator (Fig. 1) by spring hooks; the grain can be discharged in bulk into a wagon or into sacks. This invention has been patented by Mr. Robert S. Gabbey, of Rossville, Kansas.

SOME one suggests that trees after transplanting may be kept alive by burying a row of flower pots filled with water around the body and over the roots of the tree.





STAR FAN AND CROSSED BARS OF MICA.

The moisture which will percolate through the bottom and sides of the pots will be so gradual that two-gallon ones will hold enough so as not to require refilling for some time, and the roots will be kept moist till such time as they begin to sprout afresh.

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A Promise of Better Things.

There are distinct indications of a reaction from the intensity of the labor disturbances. No doubt, this movement toward peace and quietness received its impulse from the murderous riots in Chicago. Reasonable workingmen, who had yielded to excited feelings, saw in those events a plain indication of the direction in which they were drifting, and they shrank from the prospect. Evil not infrequently produces good, and it is probably not an unfortunate thing that the agitation of the laborers so soon culminated in such a manifestation of fiendish outlawry. If we must have sores upon the body politic, the quicker they come to a head and break the better.

It looks now as if the differences between employers and employed would have speedy adjustment, and that matters will settle down in quietness, with a promise of a strong stimulation of business. Commerce of all kinds has been dammed up for several months by the troubles, and the accumulation will sweep swiftly onward as the obstructions are removed. There has been a clear gain to all hands in two directions. First, the sensible men in the labor organizations have more control than they had three months ago. Second, manufacturers are better organized to deal with labor questions, to help each other to resist oppression, and, perhaps, to help wage earners as well as themselves by checking reckless competition.

That there will be any general reduction of the period of labor to eight hours a day appears unlikely. The obstacle to the success of this project is not so much the opposition of employers as the resolute antagonism of the great mass of workingmen. There can be no doubt that these are far too wise not to perceive that the proposed restriction simply involves a plan for depriving them of the privilege of selling to best advantage the only thing they have to sell, namely, their labor. This feeling is particularly strong among skilled workmen who are frugal as well as industrious. Many of them would much prefer to an eight hour scheme an arrangement which would secure to them frequent opportunity to earn extra pay for working overtime. It is not too harsh to assert that the bulk of the men who are eager to labor for eight hours only are just the kind of men to whom the two hours thus gained would be more hurtful than profitable. There is no greater nonsense than that contained in the theory that the two hours are wanted by men for the purpose of "improving their minds." Anybody who lives in a manufacturing town is aware that the number of workmen who care to improve their minds in any way is very small indeed. The men who have such ambition are almost invariably the very men who would vote against an eight hour law if the question should be carried to the polls. This is an assertion the proof of which is difficult, but we appeal fearlessly to our workingmen readers to declare if it is not true.

We may go a little further. The curse of the workingman in this country is the rum traffic. It is this that robs him of most of his wages, and in many cases it is in the taverns that he spends much of his spare time. It may be feared that the two hours proposed to be gained, by reducing the hours of labor, would be spent in the same places, and with them much more of the money earned. It will be remembered that all the Chicago socialists were associated with the beer saloons, either as owners or frequenters, and their places were the haunts and the rallying points of the rioters. Rum sellers wax fat upon strikes and disturbances, and they form the only class that would make a clear money gain by cutting down the hours of labor. These are hard things to say, but they are true, and they ought to be said. The money squandered in this infernal business last year would have given us good trade and workingmen good wages right along. It is not the tyranny of employers that keeps men poor. It is the rapacity and devilish greed of the liquor dealer. The fact is demonstrable, not only that wages are far higher here than in other countries, but that they are far higher here now than they ever were before, and meantime living is cheaper. The constant tendency, moreover, is to still larger wages. Everything in this country tends to improve the condition and the chances of the laborer. If he falls behind in the race, when he has health and strength, the fault is almost certainly his. No organization can help him if he squanders his money and plays the fool. He will be beaten out of sight by the man who saves his earnings and obeys the requirements of reason and sense.—*Textile Record.*

Water Tests.

Test for Hard & Soft Water.—Dissolve a small quantity of good soap in alcohol. Let a few drops fall into a glass of water. If it turns milky, it is hard; if not, it is soft.

Test for Earthy Matters or Alkali.—Take litmus paper dipped in vinegar, and if, on immersion, the paper returns to its true shade, the water does not contain earthy matter or alkali. If a few drops of sirup be added to a water containing an earthy matter, it will turn green.

Test for Carbonic Acid.—Take equal parts of water and clear lime water. If combined or free carbonic acid is present, a precipitate is seen, to which, if a few drops of muriatic acid be added, an effervescence commences.

Test for Magnesia.—Boil the water to a twentieth part of its weight, and then drop a few grains of neutral carbonate of ammonia into a glass of it, and a few drops of phosphate of soda. If magnesia be present, it will fall to the bottom.

Test for Iron.—Boil a little nut gall, and add to the water. If it turns gray or slate, black iron is present. 2. Dissolve a little prussiate of potash, and if iron is present, it will turn blue.

Test for Lime.—Into a glass of the water put two drops of oxalic acid, and blow upon it; if it gets milky, lime is present.

Test for Acid.—Take a piece of litmus paper. If it turns red, there must be acid. If it precipitates on adding lime water, it is carbonic acid. If a blue sugar paper is turned red, it is a mineral acid.

THE MINNEAPOLIS INDUSTRIAL EXPOSITION.

The people of the beautiful and enterprising city of Minneapolis, Minn., are actively engaged in arranging for their grand industrial exposition, which is to be opened on the 23d of August next. The financial department is strong and substantial, showing admirable management. The stockholders are about 2,500 in number.

The exposition has obtained, by donation of citizens, a site of 5½ acres of ground in the heart of the city, a central and commanding position overlooking the Mississippi River and Falls of St. Anthony. The site alone is worth $200,000. Including the value of the ground, the Exposition Association has a capital of $500,000, and will open its fine building free from debt.

THE GREAT EXHIBITION BUILDING MINNEAPOLIS.

The exposition building is 336×356 ft. in ground dimensions and 80 ft. high. The height to the top of the dome is 144 ft.; to the top of the main pavilion, 128 ft.; of smaller pavilions, 112 ft.; and to top of mast of great tower, 260 ft. The tower is 34½ ft. square at the base, and has two balconies, one at a height of 160 ft. and one 200 ft. high. The main entrance is 32×64 ft., the size of tower windows 14×80 ft., and of other windows 18×30 ft.

The floor space amounts to 7½ acres, which exceeds that of the Chicago Exposition building by 100,000 ft. The walls are of brick and Mankato cream colored stone. The interior will be neatly finished in a fireproof manner, and so arranged that when occasion requires it will form a single auditorium, with accommodations for 40,000 people. A spacious annex will contain the art exhibit. Isaac Hodgson & Son, of Minneapolis, are the architects of the building.

The exposition has been organized as a permanent institution. The officers and directors are all prominent citizens and business men of responsible character. Hon. W. D. Washburn is President; S. C. Gale, Vice-President; H. G. Harrison, Treasurer; W. G. Byron, Secretary; Col. L. B. Hibbard, General Manager. The exposition will be open for six weeks, from August 23 to October 3.

Leading among the industries of the city is the manufacture of flour. Minneapolis flour mills have a world-wide reputation. They are 22 in number, and furnish direct employment to 1,400 men. The value of buildings and machinery amounts to over $4,000,000, and the operation of the business involves the investment of about $8,000,000. The products for 1885 were worth $34,000,000. The mills have an aggregate daily manufacturing capacity of 35,000 barrels of flour.

Second only in importance to the flour industry is the manufacture of lumber. The 21 sawmills last year cut 316,167,166 feet of lumber, 72,202,550 lath, and 101,896,250 shingles. The total cut for the past sixteen years amounts to over 3,000,000,000 feet, sufficient material for the construction of houses enough for a city of 1,000,000 inhabitants. In one day the mills can cut 2,600,000 feet of lumber.

Besides the State University, there are 31 public school buildings in the city. The University main building was erected about twenty years ago. Several others have since been added, and one structure is now building. Of the city school buildings, the High School is the finest. It was built eight years ago, at an expense of $100,000. Three school buildings are to be erected this season. The schools have now 14,000 pupils enrolled, and the school population is rapidly increasing.

Lake Minnetonka, the leading lake resort of the Northwest, is practically a suburb of Minneapolis, being at a distance of only thirty minutes' ride by railroad. It is a lake of 15,000 acres, dotted with islands, and has 200 miles of shore. It is surrounded by heavy woods, and forms a charming retreat for summer tourists from all parts of the country. Palatial hotels and steamers have been provided.

Within the city limits are not less than ten lakes, three of which are each nearly a mile in diameter. In connection with these, a comprehensive system of public parks and boulevards is being arranged.

The world-famous Falls of Minnehaha are less than two miles from the city limits, and a few miles further below, at the junction of the Mississippi and Minnesota rivers, is Fort Snelling, a historic and picturesque place. The city territory of Minneapolis has an area of over 30 square miles, and touches, at one point, the limits of the city of St. Paul.

A detailed description of the city's many interesting features does not come within the scope of this article, but the following statement of the business and improvement record for 1885 will give some idea of the prevailing activity and progress: Assessed valuation, $68,938; new buildings erected, 3,605, costing $4,909; realty sales, 9,119 in number and $22,034,230 amount; jobbing trade, $77,060,700; manufacturing business, $63,625,000; bushels of wheat received, 32,000,000; street railway passengers carried, 9,388,017; banking capital, $5,500,000, since increased to $6,950,000; public improvements, $500,000.

Despite a share of the prevalent industrial depression caused by labor troubles, building improvements in Minneapolis are being conducted upon a very extensive scale. During the past six months, fully 2,300 new buildings have been commenced. On a conservative preliminary estimate, these will cost $6,000,000. Before the close of the year as many more building improvements will probably be inaugurated. Such rapid growth necessitates corresponding activity in the realty market. Recorded sales of real estate for the past six months have been about 6,000 in number, involving an aggregate consideration of $14,500,000. This amount will doubtless be more than doubled before the close of the year. These are actual facts that indicate the great vigor of this young metropolis.

Old Roman Lead.

Recently, while the excavations for the new gas holder tank at the Chester, Eng., gas works were in progress, a pig of Roman lead, in excellent preservation, was discovered at a depth of 23 feet below the ground. It bears on its upper surface the following inscription: IMP VESP AVG V T IMP III.; while on the side is inscribed DE . CEANGI. Its weight is 192 lb. The translation of the inscription is that it was a pig of lead, a tribute to the Roman power from the tribe in North Wales commonly known as the Ceangi. The inscription tells us that it was cast during the fifth consulate of the Emperor Vespasian and the third consulate of Titus.

This synchronizes with our date A. D. 74; and consequently it may be assumed that the pig of lead has been lying where it was found some 1,800 years. The ground where it was discovered was gravel and marl, which evidently formed part of the old river bed. Close to it was found a human skull, and another was discovered about 15 feet away. The skulls and bones of horses and oxen were also met with in or about the same place. The foreman of the works (Mr. J. Fish) at once called the attention of the company's engineer (Mr. W. Stevenson, Assoc. M. Inst. C. E.) to the discovery, and the treasure trove was placed in safe keeping. As the ground has to be excavated another three feet, further discoveries may be expected.

Progress of the United States.

In "Triumphant Democracy," a recent work by Mr. Andrew Carnegie, a Scotchman by birth, and now an American manufacturer, the author gives many interesting facts showing the progress and prosperity of his adopted country. He states that during last year 74,000 more tons of Bessemer steel were produced in the United States than in Great Britain; that more yards of carpet are made each year in Philadelphia and the vicinity than in all England, Wales, and Scotland; that the school libraries alone in this country contain 12,000,000 more books than all the public libraries of Europe combined; and that all the State and city debts of the Union added together, rating them according to valuation of property, do not amount to one-fifth the city debt of Manchester, Eng., or to one-tenth the debt of Birmingham.

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THE MEIGS ELEVATED RAILWAY.

The roadbed and rolling stock of the railroad of today have reached their high standard through the labors of countless ingenious and persevering inventors, each of whom has added his link to make the chain more perfect; even the smallest detail shows the combined talent of many industrious workers, one taking it up, advancing it a step, and then giving place to another. It therefore seems peculiar to be called upon to describe a new method of railroading designed as a whole by one man—a new railroad from the ballast to the top of the smokestack, from the pilot to the coupler on the last car.

The system herewith illustrated is the invention of Mr. Joe V. Meigs, of Lowell, Mass., and has been tested under conditions far more exacting than would be found in actual practice. The road is not a model, but a full-sized elevated railroad in every respect. This was made necessary by a section in the act of the Massachusetts Legislature authorizing the incorporation of the Meigs Elevated Railway Company, which states that "no location for tracks shall be petitioned for in the city of Boston until at least one mile of the road has been built and operated, nor until the safety and strength of the structure and the rolling stock and motive power shall have been examined and approved by the board of railroad commissioners or by a competent engineer to be appointed by them." To fully demonstrate the possibilities of the road under widely varying circumstances, the company has built tracks of several kinds—wooden way of the cheapest possible kind; wooden way following the contour of the earth; wooden way with level grade secured by varying the heights of the posts; wooden way with very short curves and steep grades; and iron way upon high grades, increasing in height until a level of 14 feet in the clear above the earth was secured. The trial road, beginning at the shops of the company on Bridge St., East Cambridge, has one curve of 50 feet radius, 165 feet long, on a grade of 120 feet, and on level and curves has grades of 240 feet, 300 feet, and 345 feet. So far everything has worked in the most satisfactory manner, the train rounding the exceedingly sharp curves easily, and mounting the steep grades without trouble.

The peculiar features of this road, wherein it differs most essentially from the ordinary railroad, are the way, switch, trucks, passenger cars, engine, drawbar, and brakes.

The posts for an iron way are made up of two channel bars united by two plates, thereby forming a box-like structure whose cross section may be varied as demanded by location. The posts are to be placed upon foundations, the plans of which vary to suit the character of the material that may be encountered.

The way upon which the train runs consists of a single iron girder 4 feet in depth for each span, placed over the center line of the posts. The girder carries an upper track beam and a lower track beam, upon the sides of each of which the rails, four in number, are placed. The two bearing rails, which carry the load of the train, consist of angle irons placed upon the outer upper edge of wooden stringers upon the lower track beam. These stringers are placed in the exterior recesses formed by two channel bars properly secured to the sides of the posts. These rails are fastened to each other, to the stringers, and to the track beam by bolts passing clear through. Two vertically placed rails for the balancing or friction wheels are carried by the upper track beam. The distance from out to out between the lower rails is 22½ inches, this being sufficient to insure the necessary transverse stiffness. This is the gauge of the road. The distance between the upper rails is 17½ inches. It is expected to adopt the common form of rail, beveling the edges of the lower stringers and placing the rail at an angle of about 45 degrees. In our engraving, the rails are in the form of a right angle, and the treads of the wheels are made with a corresponding right angle groove. The usual length of post, 24 feet, would give a clear headway of 14 feet, 4 feet being taken up by the truss and 6 feet forming the foundation.

The switch is formed of a single swinging section turning upon a hinge of great strength attached to one of the posts. A movement of four or five feet by the free end of the switch is enough to permit the cars and trucks on one track to clear the end of the other track. The free end travels upon a carriage provided with rollers moving upon a supporting rail. Suitable mechanism is provided for operating the switch and locking it in place.

The truck is a development of the conditions controlling the adoption of the permanent way. It consists of a horizontal rectangular wrought iron frame, stiffened by cast iron pieces and provided with stiff pedestals bolted to its under side, in which is a fixed short axle for the wheels. Each truck has four wheels set at an angle of about 45 degrees, the axles being properly inclined. Between the supporting wheels are two horizontal wheels, one on each side of the upper girder, upon vertical axles attached to the frame; these wheels bear upon the rails of the upper truck beam, and are kept in yielding contact with the rails by springs outside the boxes, and serve as balancing wheels to take the side oscillations of the cars. They are formed with flanges that pass under the lower edges of the rails, thus tying the truck to the rails, so that no lifting or jumping can take place, and there is no possibility of the trucks running off the track. The wheels are 42 inches in diameter, have a tread of 3½ inches, and rotate independently of each other. In case any or all of the wheels should break, provision is made to prevent the cars from overturning or leaving the track, by means of a strong shoe, which would slide upon but could not leave the way. On top of the truck frame is a movable iron frame carrying four posts containing heavy spiral springs. These posts interlock with similar spring sockets bolted to the framing of the floor of the car, which is directly above the truck and within 18 inches of the top of the girder. The truck is guided in turning by a center pin, and is securely tied to the car body, as the horizontal flanges of its frame castings overlap the rim of the upper turntable. In passing curves and switches, the trucks turn upon the balancing wheels, placed centrally between the supporting wheels, which are 4 feet apart.

It has been found that, by reason of the independent motion of all the truck wheels, curves are followed so closely that practically the increase of friction of the cars upon curves even as small as 50 feet radius is too slight to be noticed or measured by weighing in a model one-eighth full size. This construction of the trucks also admits of a car 50 feet long turning from a street only 28 feet wide into another of the same width.

The cars possess many novel features, both outside and inside. The circular section and rounded ends admit of the strongest possible construction without an overweight of material. The floor consists of a platform made of 5 inch channel beams, and is 7½ feet wide by 51 feet 2 inches long. The framing of the body is of light T iron ribs, bent in a circle, filled in by panels covered with rich upholstering, which covers all the interior; the exterior is sheathed with paper and copper. The cylindical portion is 10 feet 8½ inches in diameter. While adding to the strength, this form is expected to diminish the wind resistance fully one-third. The interior of the car, as shown in Fig. 1, is light, roomy, and pleasing to the eye. The seats are upholstered like the rest of the car, and comfort and luxury have been carefully studied in every detail. At each window is a specially designed device for securing ventilation without the annoyance caused by dust. There is an entire absence of sharp corners, so that, in case of a serious accident, the liability of the passenger being greatly injured is largely avoided.

The locomotive consists of a platform car supported upon a truck at either end and housed like the passenger car. The floor is 7½ ft. wide by 29¼ ft. in extreme length; the tender is 25⅝ ft. long, has a tank and bin for the water and coal, besides additional room which may be used for other purposes. Upon the floor of the engine are, in effect, two complete stationary engines, each connected with a single driving wheel. The boiler is of the locomotive type, is 60 in. in diameter, 15 ft. in length, and is placed over the engines, its center line being 61 inches above the floor. There are 200 tubes, 2 in. in diameter and 7 ft. long; the grate is 4½ ft. square. The crown sheet is arched in shape, and is inclined downward at the back end to allow of climbing and descending grades equal to 800 feet to the mile without exposing any uncovered part to the fire. The cylinders are 12 by 22 in., and their center lines are placed 18 in. above the floor and 61 in. apart. The piston rods connect with independent crossheads sliding upon steel girders supported at their ends by standards bolted to the floor beams.

The driving wheels are 44·6 in. in diameter, flanged upon their lower edge like the balance wheels of the trucks, and are mounted upon steel axles 6 in. in diameter, which extend through a sliding box containing the journals. The boxes slide in cast iron ways placed at right angle to the line of the engine, and each axle has a crank keyed upon its upper end. The well known slotted yoke connection is used. The slide valves are of the usual locomotive form. The links are placed in a horizontal instead of a vertical position, and are operated by two bell cranks. The throttle valve, link rod, brake, and coupling rods, and the connection between the driving boxes for producing pressure against the rails, are operated by hydraulic power, although hand levers are also provided.

Adhesion of the driving wheels to the rails is obtained by means of a cylinder and piston secured to the sliding boxes. The engineer is on an elevated platform in the front part of the engine, the fireman being at the rear end. The former has an unobstructed view through the windows of the monitor roof, and before him are five hydraulic cocks, which control the throttle, links, sliding boxes of the driving wheels, the brake, and the coupling rods of the entire train, while just above are steam and hydraulic pressure gauges and indicators, whistle and bell ropes, etc. With an engine thus furnished with provisions for griping the rails, steep grades become of minor importance, as the steepest possible can be ascended if the requisite power is provided.

One turn of the cock controlling the couplings divides the train into segments of separate cars, each of which has a brake which acts automatically upon detachment from the train. This partially destroys the momentum of the whole, and a collision could only take place by a succession of comparatively light blows from the engine and slowing sections of the train, instead of by a single blow with the momentum of the whole train.

The brakes are operated upon the balancing wheels of the trucks, but they may also be fitted upon the supporting wheels. The action of the brakes is well illustrated by rails between the rolls of a rolling mill, except that the action is reversed. It is apparent that no slipping of the wheels can take place, no matter what pressure may be brought to bear upon them.

In the illustration, Fig. 2 is a plan view of a train on a sharp curve, Fig. 3 is an end view of the track and engine, Fig. 4 is a section through tender and track, and Fig. 5 is a section through the car.

From the foregoing it will be seen that this system is as applicable for surface as for elevated railroads. It may be more cheaply built than the ordinary road, as the construction of the rolling stock allows the contour of the ground to be more closely followed. As an elevated road in cities, the permanent structure presents far less obstruction to light and air than the usual form. The center of gravity of the cars and engine is brought as low as possible, thereby lessening the effect of leverage caused by wind pressure. The smooth, even surface of the exterior of the entire train serves to decrease the resistance to the wind, and permits a high rate of speed.

The Salt Mines of Nevada.

If the salt formations of Nevada were in railroad communication, there would be no market in this country for the foreign article. In Lincoln county, on the Rio Virgin, there is a deposit of pure rock salt which is exposed for a length of two miles, a width of half a mile, and is of unknown depth. In places, canons are cut through it to a depth of 60 feet. It is of ancient formation, being covered in some places by basaltic rock and volcanic tufa. The deposit has been traced on the surface for a distance of nine miles. It is so solid that it must be blasted like rock, and so pure and transparent that print can be read through blocks of it a foot thick. At Sand Springs, Churchill county, there is a deposit of rock salt 14 feet in depth, free from any particle of foreign substance, which can be quarried at the rate of five tons a day to the man. The great Humboldt salt field is about fifteen miles long by six wide.

When the summer heats have evaporated the surface water, salt to the depth of several inches may be scraped up, and underneath is a stratum of pure rock salt of unknown depth. Soda, borax, and other valuable minerals also exist in large quantities near these localities, and branch railroads will sooner or later bring them into market. A considerable business in gathering borax is already established on the line of the Carson & Colorado Railroad. If Nevada will cut down her working expenses and develop her natural resources, she will be above the necessity of seeking land grants from her neighbors or from the general government.—*San Francisco Bulletin.*

The Effect of Heat on Metal.

Everybody, observes one of our contemporaries, who has used the Brooklyn Bridge, must have noticed the overlapping slides at the middle of each span that allow the structure to grow short or long as the weather is cold or hot, and the marks thereon that indicate a distance of several feet between the extremes of contraction and expansion. Yet few suspect that the bridge contracts or expands sideways from the heat of the sun, though the degree is so small as to be almost imperceptible, and not nearly so great as if the bridge ran north and south. The same phenomenon has been noticed of late in structures of stone and iron. The Washington Monument leans to the east in the morning and to the west in the afternoon. A plummet line suspended in the interior of the dome of the Capitol at Washington was found by actual measurement to swing over a space of 4¼ inches, making a total dip from the perpendicular of 8½ inches. This movement involves the entire dome. Some years ago a learned monk in Rome suspended a plummet in this way from the top of the dome in St. Peter's, and was astonished to find this mysterious movement. He attributed it to a third and undiscovered motion of the earth, but it was afterward explained as the effect of the action of the sun on the metal of the dome.

REFERRING to our navy, a daily paper reports the Atlantic Squadron as being under sealed orders to proceed to the scene of the recent fishery troubles. It is further facetiously remarked that the fishermen will protect the navy while upon the excursion.

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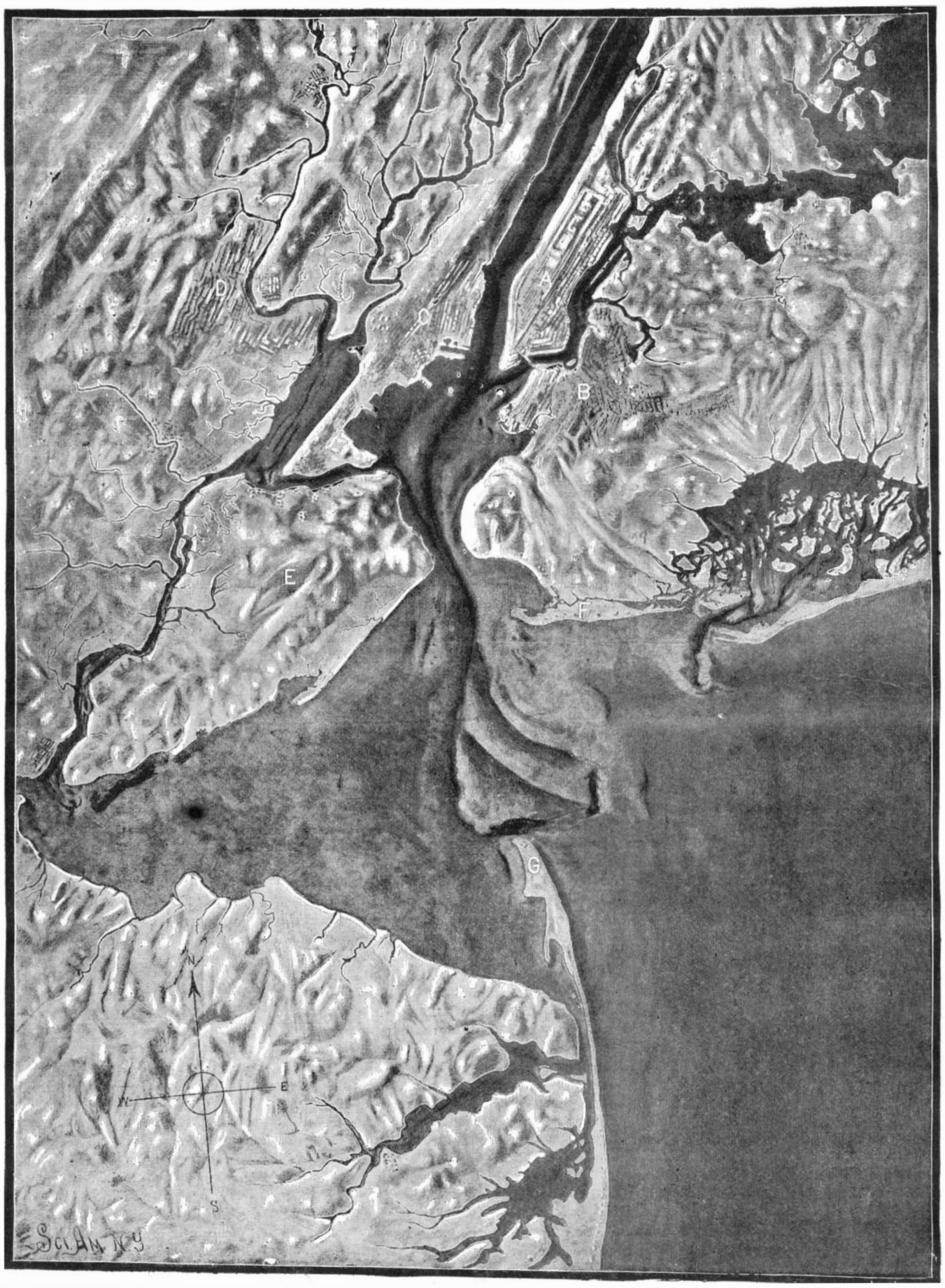
NEW YORK HARBOR.

The Chamber of Commerce some months ago was petitioned by a large number of merchants and agents of shipping to take some action looking to the erection of an enlarged and, if possible, more convenient channel into this port. Its committee on this subject called a public meeting, and formed a large general committee on harbor improvements and protection, embracing a number of the most influential men connected with public affairs and commerce. This meeting also resulted in an earnest petition to Congress, asking that the Secretary of War be authorized to advertise for and "contract with responsible parties for the speedy deepening and widening of a channel to afford 30 feet depth of water and not less than 500 feet in width at mean low tide, which would afford 35 feet and a width of 1,500 feet at high tide, in and through that part of the bay at Sandy Hook which experience and judgment indicate as best calculated to be permanently maintained by nature alone after the first guiding and aiding works have been constructed." It was intended that nothing be paid until the object be partly attained—the profits and a large proportion of the expense to be entirely dependent upon the self-sustaining character of the work. The necessity for such relief has been most apparent and pressing for a long time, and it only needs to glance at the change which has taken place in the requirements of vessels (Fig. 1) to be strongly impressed with this fact. The memorial was forwarded to Congress and presented in the House, but as yet no specific action has been taken. The Chairman, Mr. A. Foster Higgins, of the Standing Committee of Harbor and Shipping, caused to be initiated on behalf of the Chamber of Commerce of New York a simple, plain, and business-like way of grappling with the subject. Two years ago, work was commenced by having a series of historical maps and models made. These clearly indicate the areas on which extensive improvements might be undertaken. The numerous maps, extending back 150 years, embrace the entire harbor from Long Branch on the south to Yonkers on the north, the east side of Jamaica Bay on the east and Raritan River, just west of Perth Amboy, on the west. There are also sectional maps giving all the changes that have taken place in the outer bay between Sandy Hook and Coney Island from 1735 to 1884. The alterations in Coney Island and Sandy Hook are especially interesting as clearly showing how important their protection and retention are to the maintenance of the present and improved depths in the outer bay. Although these maps cover the larger part of the subject, it is still necessary to make continuous and simultaneous tidal and current observations in order to secure the factors with which to calculate the velocity, direction, volume, and exact effect of each separate body of water upon each channel or upon any harbor works that might be erected.

This important map work was followed by the carving in wood of several models. The accompanying illustration is a photographic reproduction of the general small scale model, 3¾ inches to the mile, which represents an area of 800 square miles inclosed within the limits above mentioned. The heights and depths of the hills and valleys, and the channels and shoals in the upper and lower bays of New York Harbor, are accurately carved from solid wood. The wooded and marshy regions and the buildings of the cities and villages are all indicated in relief and appropriately painted. When water is let into the depressions which represent the ocean, bays, and tributary rivers, we obtain an effect as perfect as though the region were viewed from a balloon.



A, NEW YORK CITY. B, BROOKLYN. C, JERSEY CITY. D, NEWARK. E, STATEN ISLAND. F, CONEY ISLAND. G, SANDY HOOK.

BIRD'S EYE VIEW OF NEW YORK HARBOR, WITH WATER REMOVED.

This work, which has now occupied some two years, has been intrusted to Capt. F. I. Palmer, C.E., and a corps of able assistants; the results show the untiring industry expended in collecting necessary data, which has been so arranged that every valuable detail can be brought into service.

To thoroughly understand the character of the bottom of the outer bay, it is necessary to study carefully the force and directions of the currents passing between Sandy Hook and Coney Island, which are distant from each other 7 miles. The accompanying outline map, or key to the large view, will serve to make the following description plain.

The outer bay is scoured by two great forces—one, from the inner harbor through the Narrows, made up of the Hudson and East River, Long Island Sound and Newark Bay waters, and the other, from the outer harbor, a compound of Raritan Bay, Raritan River, and Arthur Kill waters with those from Sandy Hook Bay and the Shrewsbury and Navesink basins. Both of these forces pass seaward between Sandy Hook and Coney Island, being divided by the Dry Romer shoals, and it is estimated that the quantities of flood tide waters are almost identical on either side of the shoal, while the ebb tide waters are from ten to fifteen per cent stronger over the east bank and through the channels north than through the channels on the south side of this shoal. It is probable that none of the waters that pass through the Narrows on the ebb tide ever flow south of this shoal, except at the seaward end of the bar, and under special conditions, such as high freshets or the backing up of the waters by unusual winds. The water flowing through the Narrows, although coming from three distinct sources, may be regarded as a single stream running in a southerly direction so far as the effect on the channels of the outer bay is concerned. The outer harbor waters, on the other hand, are divided into two independent forces which only unite on the same course as they elbow their way through the opening between Sandy Hook and Coney Island, the Sandy Hook force running northerly directly opposite to the inner harbor waters, and the Raritan Bay force easterly and at right angles to both, these latter waters squeezing their way between the others and forcing them to assume like itself an easterly direction and keep their own side of the way. The constancy of these forces is shown by the fact that the sand bar fronting the entrance has maintained its position and depth with very slight variation during the past fifty years. This bar is the result of the flood tide from the ocean and storm wave power on the one hand as opposed to the ebb tide and freshet power on the other.

The extensive inner bar, west and alongside of Flynn's Knoll, has during the past 150 years, with two doubtful exceptions, only varied 3 feet in depth. The Dry Romer has been nearly equally constant. The outer bar, or Gedney's Channel, has not varied 4 feet during the above period.

The only two channels in use at the present time

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are the Main Ship and Swash, Gedney's Channel giving them common access to the ocean across the outer bar. The former, although much longer and requiring five different courses to navigate it, is principally used, owing to its deeper water. A third channel, called the East, requiring only two different courses, was only known in an official and published form in 1835, when the work of the U. S. Coast Survey was begun. During the past fifty years this channel has proved the most constant of the three; the deep water area had, as shown by a careful comparison of official surveys, improved twelve per cent in 1857, fifteen per cent in 1872, and 30 per cent in 1884 over its state in 1835. The depth over the bar fronting it, the only obstruction to a free and unimpeded channel to the ocean, has deepened about 2½ feet.

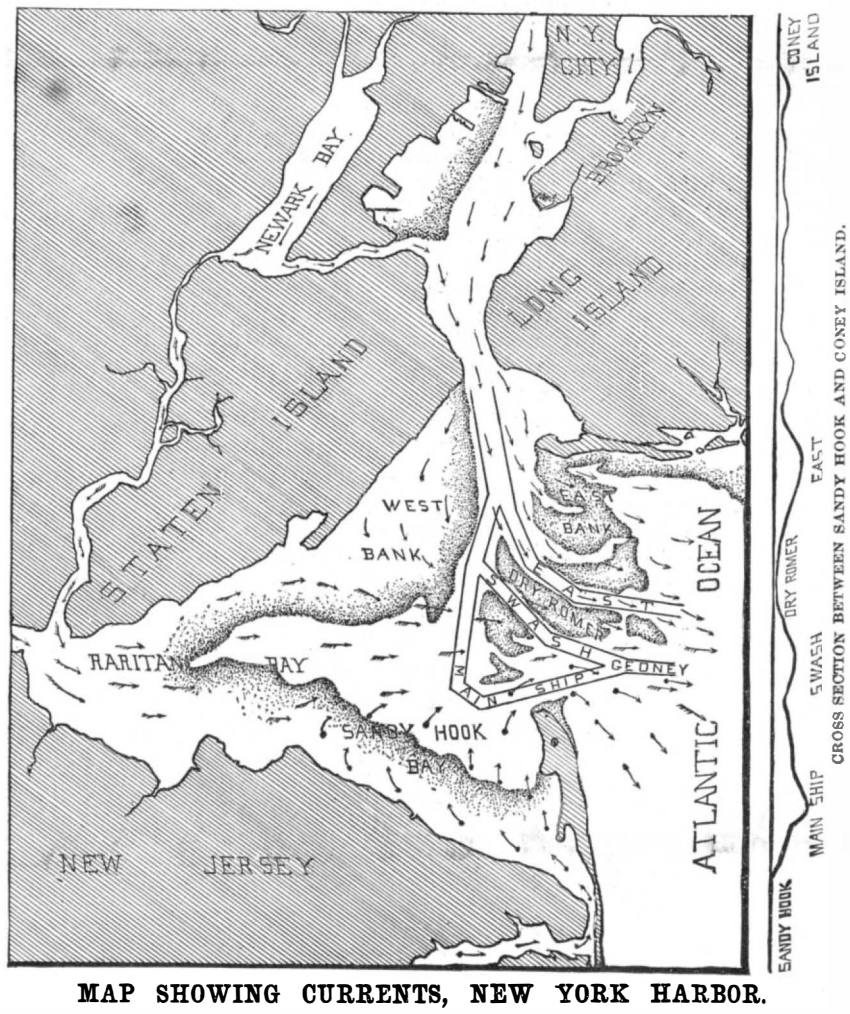
In response to the general demand for more water, there are to-day several proposals for effecting the required relief. Probably the oldest plan is to build an artificial bar well out in the ocean to prevent the storm sand from being driven on the natural bar; another is to dredge a channelway through the outer and inner bars of the ship channel, and protect the places so dredged by submerged jetties; a third is to run stone dikes northeast from Sandy Hook and thus contract the entrance; a fourth is to let the existing channels alone and to dredge out and maintain by jetties the East Channel, thereby obtaining nearly a direct line into New York; a fifth, and last, the construction of a stone dike running south-southeast from Coney Island for a distance of about 4 miles across the entrance, to greatly confine the waters and force them to scour the channel out. These plans cannot be all right, or even reasonable; some would probably ruin the port. It would therefore seem prudent, considering the enormous interests involved, to ascertain without delay the exact movements and relations of the forces to each other as affecting the several channels. The question arises, apart from the great saving in distance, whether the East Channel is not the best one to improve; only one set of waters from the inner harbor passes through it, and there is no collision of currents to cause deposits; while the Main Ship and Swash channels have two and three conflicting forces at work over their area. But before any particular method is adopted, it would certainly be wise and prudent to acquire, by a series of accurately made and extensive observations, an absolute knowledge of the velocities and directions of the moving waters at every depth. The problem to be solved is how to improve one of the existing channels with the least possible disturbance of the present regimen of the harbor. The run of the tides must be coaxed by science, and not opposed by brute force.

There is a bill now before Congress, introduced by Senator Warner Miller, authorizing the appointment of a commission of five practical men, to consider the best means for preserving the harbor from injury by dumping and other abuses which impair its usefulness, and also from time to time to report any improvements that may be desired to the Secretary of War, who shall transmit them to Congress. Three of the five will be officers of the U. S. Engineer Corps, the Navy, and Coast Survey departments appointed by the President, and two will be civilians nominated by the Governors of New York and New Jersey, a board eminently fitted to consider the question of permanent improvements.

Any work that would augment the commerce of New York by providing a shorter, deeper, and in every respect a better entrance to the harbor would be of national importance, and should therefore be undertaken by the general government, under whose control it very properly belongs, and not by the States of New York and New Jersey.

The rapid increase in the draught of large ocean steamers and the sharp competition in speed of the several lines make necessary the deepening and straightening of the channel if we still desire these vessels to anchor at our docks. Even now the largest vessels can only come in during certain stages of the tide, and the least deviation from their course insures grounding.

If we do not desire their presence, an active indifference will in a very short time compel them to seek other harbors. The builders of steamships have attained speed and size to satisfy public demand, and they will not be likely to sacrifice these features by so changing their models that they may easily enter New York Harbor.



MAP SHOWING CURRENTS, NEW YORK HARBOR.

BY a very careful test it, has been found that the strength of a Bushman's forearm compares with that of an Englishman of the same weight as 55 to 85.

The Proposed Permanent Exhibition of the Three Americas.

On the 4th of March, 1889, the Constitution of the United States will have completed the first century of its existence, and on the 12th of October, 1892, four centuries will have elapsed since the discovery of America by Columbus. These two anniversaries are events of the greatest importance in both the history of the United States and of the world. It is therefore thought eminently fitting that they should be celebrated by the nation at large, in a manner suited to the dignity of its position. The approach of two occasions of such historic interest has been the incentive of a number of proposed exhibitions in different American cities. New York, St. Louis, Chicago, and the city of Mexico have each started

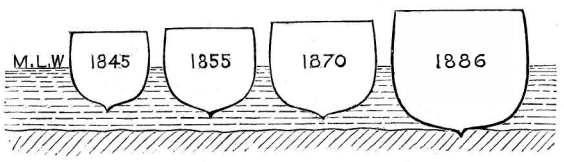


Fig. 1.—SECTIONS SHOWING GROWTH OF OCEAN STEAMERS.

movements toward the organization of expositions in honor of one event or the other. But the importance of the one, affecting equally the entire United States, and of the other, being the dawn of history for the whole hemisphere, makes a more concerted and widespread celebration desirable than could be attained by a private corporation or by local enterprise. The proposition has therefore been made, and is now under Congressional consideration, that the celebration of these two anniversaries shall be undertaken by the general Government, and shall take the form of a grand Permanent Exhibition of the Three Americas, intended not only to commemorate the common starting point in their several histories, but to serve not less for drawing them together into closer commercial and political relations.

The city of Washington has been appropriately named as a suitable location for such a gathering. It is a city in which we all have a common interest; and in no other place could a celebration be so entirely a national affair, and so devoid of local or sectional feeling, as on national territory. The peculiar character of the city, moreover, specially adapts it to such a purpose. The large parks and government reservations, containing in all about 1,000 acres, are located right in the heart of the city, so that the exhibition buildings would be more easily accessible than would be possible elsewhere. Their permanency likewise would be a most desirable feature at the national capital, since it is becoming each year more and more the scientific, literary, and social center of the entire country. The treasures gathered in such an exhibition would therefore be seen and enjoyed by a greater number of persons from all parts of our extended territory than could possibly be the case in any other locality. Already the presence of such institutions as the Smithsonian, the National Museum and Library, and the Patent Office has created an atmosphere of learning, which attracts an increasing number of students and investigators.

It is quite time that some decisive action should be taken if the occasion is to be observed in a fitting manner. Less than three years remain before the completion of the constitutional century. We can do little more than inaugurate the movement by 1889, but by 1892 it should reach a grand consummation worthy of our land and hemisphere. It is proposed that, on this occasion, the President of the United States, the presidents of the fifteen American sister republics, the Emperor of Brazil, the Governor-General of Canada, the King of Italy, in whose domain Columbus was born, and the Queen-Regent of Spain, from whose country he set sail, shall unite in unveiling a colossal statue of the illustrious discoverer of America, to be erected in the center of the permanent exhibition grounds at Washington.

Relation of Mechanics to Architecture.

The different styles of architecture may to a certain extent be distinguished and classed according to the kind and the greater or less complexity of the principles which regulate the stability of the structure. The simplest kind of stability is that of a single mass resting on a base; this is exemplified by pyramids, obelisks, and solitary pillars. Next in point of simplicity is the stability of a load resting on a lintel whose two ends are supported by pillars, each of sufficient dimensions to be stable in itself. This we find exemplified in Egyptian and Greek architecture, and in those examples of Roman architecture from which the arch and dome are absent. The next degree of complexity consists in supporting the load on each pier of which the structure consists by a pair of pressures inclined to each other—that is, by introducing the arch and dome—and this we see in later examples of Roman and Italian architecture, and in various styles of the earlier middle ages, such as the Byzantine, the Lombard, and the Anglo-Norman.

The perfecting and extending the application of the arch, so as to sustain the entire load of the higher parts of the structure by means of the thrust exerted through ribs suitably formed and arranged, characterizes Gothic architecture. The balancing of overhanging loads is seen to a certain extent in the beetling bartizans and turrets which form the most picturesque feature of the Scottish baronial style. The balancing of bulky arches upon comparatively slender pillars, whose lateral stability depends very much on their connection with the mass above them, is characteristic of Saracenic architecture. The styles of framework in roofs and in buildings of wood and iron might be classed in a similar manner, according to the way in which the principles of statics regulate the stability of the structure. Another mechanical characteristic of styles in architecture is the way in which the strength of the materials is exerted. In the obelisk, pyramid, and simple tower or column, resistance to crushing is also brought into play; and the same is the case with the most elaborate combinations of ribs, groined arches, and tracery in Gothic architecture. In the styles which employ architraves supported by pillars, the transverse strength of lintels or beams is also employed. The support of overhanging loads requires the transverse strength of corbels and cantilevers, and in some cases the tenacity of cement and cramps. Timber and iron framework bring every form of strength into requisition. A subordinate distinction of styles, founded also on mechanical principles, depends on the hardness and durability of the material of the building. For example, a certain plainness of style, which if executed in granite constitutes majestic simplicity, appears poor and bare in sandstone, and paltry in brick.—*Professor Rankine, in the Architect.*

Fast Time.

The master car builders held their annual convention at Niagara Falls recently, closing June 11. The Western members were taken by a special train of four cars over the Great Western Division of the Grand Trunk, and a remarkably fast run was made: leaving Niagara Falls at 9:45 A.M. and arriving at Windsor, a distance of 229½ miles, at 2:55 P.M.—5 hours and 10 minutes, including stops, of which there were 13, and three of them 17, 10, and 8 minutes respectively. Excluding stops, the run was made in 3 hours and 57 minutes—or 229½ miles in 237 minutes. With the exception of 11 miles on the Copetown grade, a uniform speed of 60 miles an hour was maintained throughout, and the roadbed is in such excellent condition that the cars ran so steadily that it was observed water in a glass nearly full on the table did not spill.—*Toronto (Ont.) Railway Life.*

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THE HALL TYPE WRITER.

The first record of a type writing device was in 1714. In that year there was issued from the British Patent Office a document referring to "An Artificial Machine or Method for the Impressing or Transcribing of Letters Singly or Progressively one after another as in Writing, whereby all Writings whatsoever may be Engrossed in Paper or Parchment so Neat and Exact as not to be distinguished from Print."

Henry Mill was the inventor. No record of another attempt appears till 1841. In 1859, Mr. Thomas Hall, of New York, invented a machine, which was completed in 1866, and sent to the Paris Exhibition in 1867. In 1881, the same inventor patented the writer now manufactured by the Hall Type Writer Company, of Salem, Mass. The present Hall type writer is a wonderful little machine. It is claimed that it has the greatest capacity of any machine in the market. It has no inked ribbon, as have the various keyed machines, but prints directly from the face of rubber type, thus avoiding the chance of blurred work. The type forms are interchangeable. Fifteen styles of English are made; also type in Greek, French, German, Spanish, Portuguese, Italian, Dutch, Norwegian, Russian, Swedish, etc.

The portability of the "Hall" writer is a prominent feature. Its weight is only seven pounds, and it is inclosed in a handsome box, usually of black walnut, but the case may be of any sort of wood, or covered with plush or leather. A handle is attached, for readiness in carrying. It seems incredible that such a little machine should work such wonders, but "the proof of the pudding is in the eating."

The Hall manufactory is at 194 to 200 Derby Street, Salem, Mass., and it is a well stocked and well organized factory. Various special machines and tools are required for the work, four of which are shown in our illustrations. All the parts of the machine are made with extreme care, and each part is nicely adjusted and fitted.

All the working parts of the machine are contained in a frame formed of end pieces and longitudinal bars, the frame being pivoted in the box containing the instrument, so that it may be elevated to any desired angle. The upper bar of the frame is a graduated scale carrying the stop for limiting the return motion of the carriage, and the bell for indicating when the end of the line is reached. The second bar is cylindrical in form, and is provided with series of circumferential equidistant grooves, which bear a fixed relation to the spacing of the lines.

The carriage which sustains and guides the principal working parts of the machine is formed of two parts mounted pivotally on the circumferentially grooved bar, the lower part carrying the inking pad and the feeding mechanism, the upper part carrying the feeding spring and the ingenious parallel movement which characterizes this machine.

The inking pad is mounted upon a plate having an aperture opposite the point of printing, and the upper part of the carriage is provided with an impression screw directly opposite the aperture in the lower part. Between the upper and lower part of the carriage is arranged a system of arms by which a perfectly parallel motion in two directions is secured, and upon the mechanism of the parallel motion is secured the rubber type plate, which is furnished with the letters and characters to be impressed upon the paper.

An arm extends from the support of the type plate outward, in front of the machine, between the upper and lower portions of the carriage. To this arm is pivoted a single key carrying a conical pin or pointer, which may be inserted in any one of a series of cavities in the index plate. In the bottom of each cavity there is a letter or character corresponding to one of the letters or characters on the type plate carried by the parallel movement; and the index plate, parallel movement, pointer, and impression screw are arranged relatively to each other so that when the pointer is inserted in one of the cavities of the index plate, the letter or character represented by that cavity will be brought under the impression screw, when the downward movement of the key will press the carriage downward, bringing the impression screw into contact with the back of the type plate, and pressing the particular letter of which an impression is required downward into contact with the paper lying over the third bar of the main frame.

The power for feeding the carriage forward is supplied by a spring contained by the drum mounted on the top of the carriage, and provided around its periphery with teeth engaging the circumferential grooves of the bar upon which the carriage is mounted. The spring is wound whenever the carriage is returned to the point of starting, and the forward step by step movement of the carriage is effected by an escapement, mounted on the right-hand side of the carriage and working into the circumferential grooves of the bar. The escapement is arranged so as to permit the carriage to move forward a distance equal to one or two divisions of the bar, as the character of the work may require, the change in the spacing being effected by a small cam at the side of the carriage.

The escapement key is mounted on the lower half of the carriage, in position to be engaged by the upper half of the carriage, when the latter is pushed downward in the act of printing; and to the forward extremity of the key is pivoted a finger piece, which may be depressed so as to operate the escapement independently of the printing mechanism. Upon the spacing key is mounted a latch, which may be moved independently of the key when it is desired to shift the carriage quickly in either direction. When the spacing key is depressed, it engages one of the grooves of the rounded bar, and at the same time lifts the latch out of engagement with the groove in the upper side of the bar, when the latch springs laterally one or two spaces, according to the adjustment of the spacing key; and before the key is released from the groove in the bar, the latch enters a groove in the top of the bar, so that, when the key is entirely withdrawn from the groove of the bar, the carriage will be liberated and moved forward until its motion is arrested by engagement with the latch.

Under the longitudinal bar of the main frame, upon which the printing is done, is located a paper-feeding roll, which is partly incased by a semi-cylindrical metallic casing which shuts over the paper and over the beveled edge of the printing bar, and holds it accurately in position for printing, and also presses the paper into close contact with the rubber paper roll, so that, whenever the roll is turned, the paper will be moved forward for a new line. The shaft of the paper roll is provided with a milled head at one end, by means of which it may be turned to move the paper forward or backward as may be desired. In the inner face of the milled head are formed radial notches,

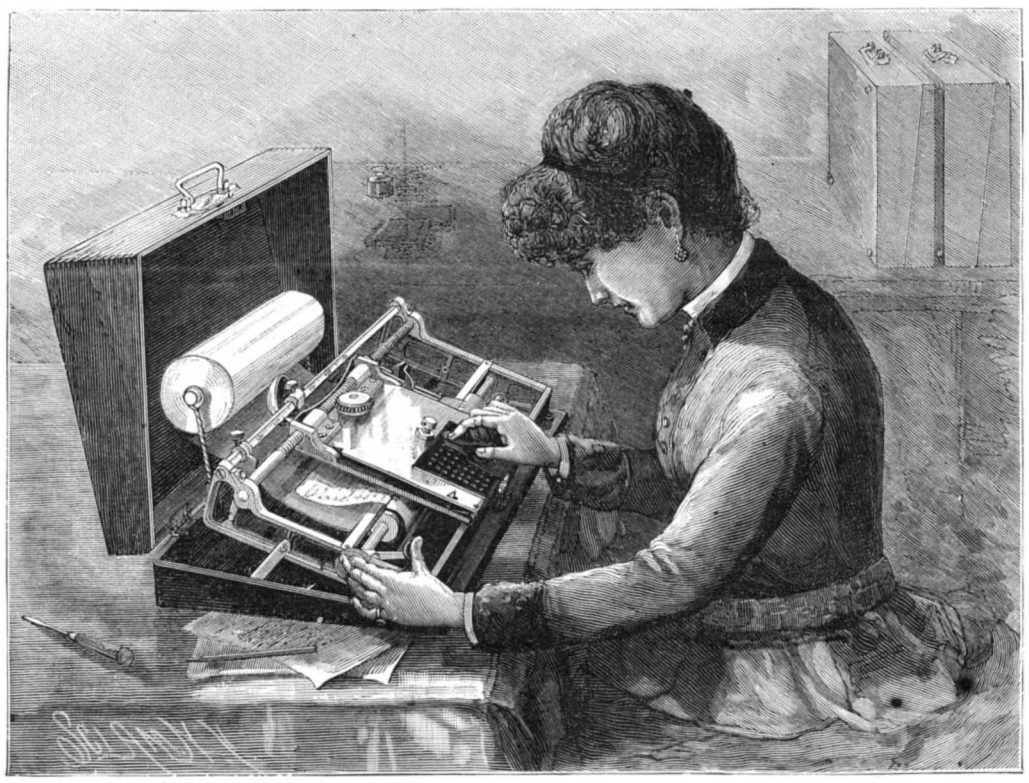

Fig. 1.—THE TYPE WRITER IN USE

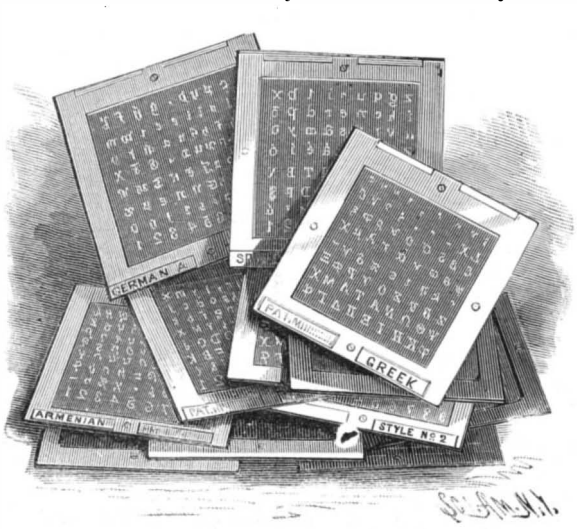

Fig. 3

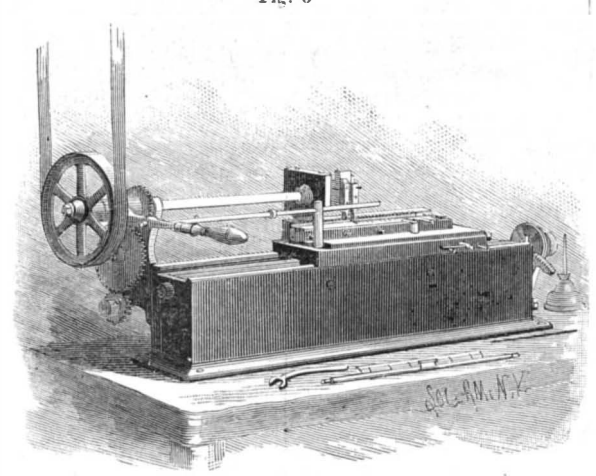

Fig. 4.

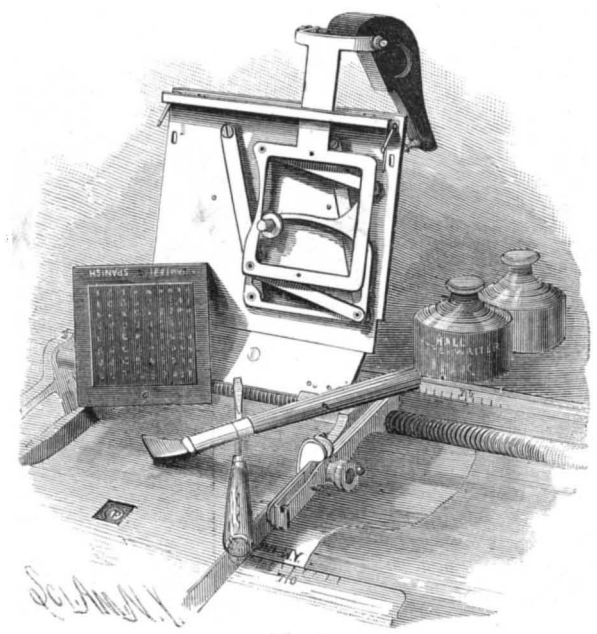

Fig. 2.

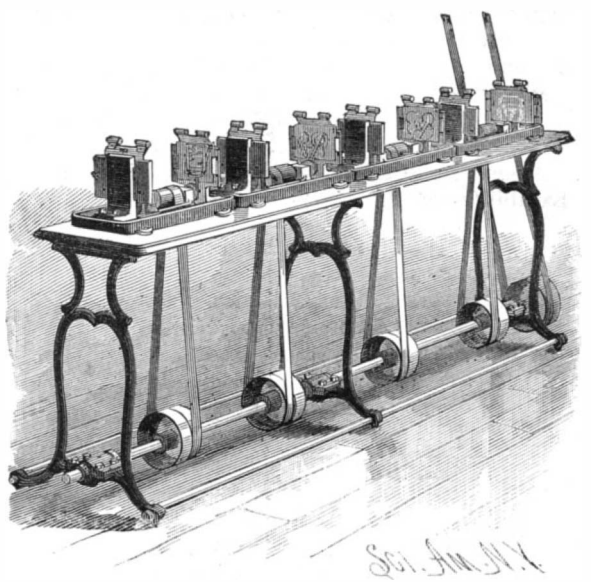

Fig. 5.

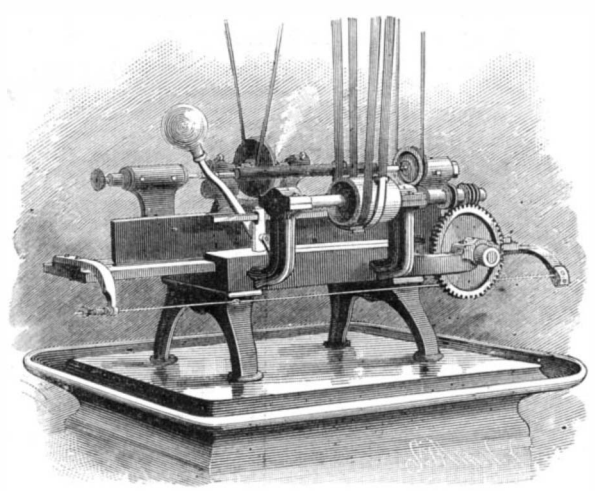

Fig. 6.

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which are engaged by a rounded spring fastened to the end of the frame. The spring and notches serve as a stop for spacing the lines. The roller shaft is also provided with a key, by which it may be turned forward the amount required to feed the paper for a new line.

The type plates are changed by loosening and tightening two small screws, and the inking pad may be lifted out and replaced by one of another color, after unlatching the upper portion of the carriage and lifting it from the lower portion.

Fig. 1 represents the type writer in use; Fig. 2, the carriage opened, showing the "motion"; Fig. 3, a group of type plates; Fig. 4, a graduating machine for the bell rods and "clips"; Fig. 5, a device for easing the "motions," that they may run smoothly; Fig. 6, a machine for grinding the rubber rollers; Fig. 7 illustrates the process of vulcanizing type plates and rubber rolls. The Hall type writer was awarded the medal of superiority at the semi-centennial fair of the American Institute, in New York, and the John Scott Medal by the Franklin Institute, of Philadelphia, an honor conferred on no other writer.

The Hall type writer has many points peculiar to itself which cannot be claimed by other writers, at the same time doing all the varieties of perfect work that are done by any writer. The Hall type writer is exceedingly simple, having only a fraction of the parts possessed by the keyed machines. It is perfectly portable, being of convenient size, and weighing only 7 pounds.

Each type plate has seventy-three characters. Fifteen styles of type are made for writing English, and many for other languages. The printing, being direct from the face of the type, is legible like ordinary printing. The machine takes paper of various widths and thicknesses, and will write on postal cards or envelopes. It will print with single or double spaces as required. It allows of the making of corrections with great ease.

The most intricate blanks may be readily filled in; letterpress copies from the writing are perfect; hektograph copies may be taken by using a special ink; manifold copies are secured by the use of "manifold" type forms—six good copies being readily obtained.

Catalogues may be had and all special information obtained by addressing the office of the company, 200 Derby Street, Salem, Mass., U. S. A.

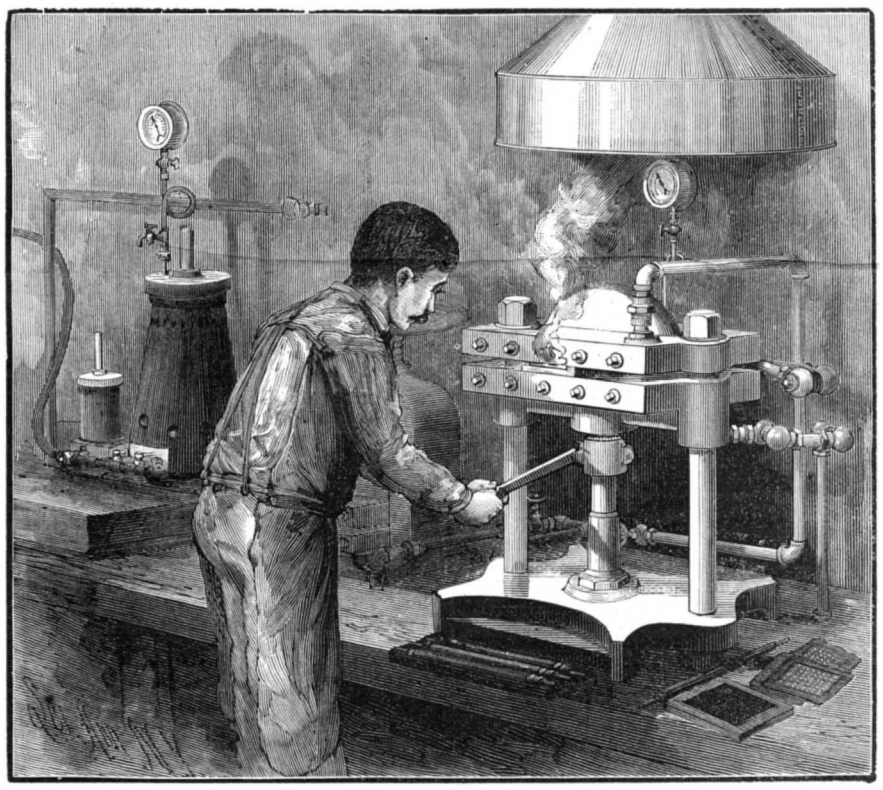


Fig. 7.—VULCANIZING TYPE PLATES AND RUBBER ROLLS.

MENNIG'S STEAM ENGINE.

Among the steam engines that figured at the Anvers Exhibition was that of the Mennig Brothers, of Curegdem. These valves are actuated by a shaft which is parallel with the axis of the cylinder, and which is driven by the main shaft through the intermedium of a pair of bevel gears. The distributing shaft carries the motive cams of the four slide valves and the helicoidal gearing that revolves the governor. The two cams of the admission valves consist of oblong sockets which slide along a square portion of the distributing shaft, and are connected with each other by a bent lever moved by the governor, which thus regulates their position, and, consequently, the duration of the admission. As soon as the cams permit it, the admission is closed by springs that act upon the valve rods outside of the distributing boxes. The escapement valves have rods that are parallel with the axis of the cylinder, and are actuated by an undulating disk fixed upon the distributing shaft. This disk communicates a backward and forward motion to a lever that acts upon the valve rods.

The governor is of the Porter style, and is provided with a cataract.

The builders have taken care to construct the sockets and valve rods in such a way that the wear to which these parts are exposed may be easily taken up.—*Chronique Industrielle.*

TRANSPARENT SOAP.—According to Wright, many of the finer grades of transparent soap sold in England do not contain glycerine, as advertised, but sugar. Sugar seems just as well adapted to making transparent soaps as glycerine. As sugar is admitted into England free of duty, and is hence very cheap, this application of it becomes possible.—*Soc. Chem. Ind.*

Great Aggregates from Doubling Small Amounts.

The delusive result or multiplying by two, or doubling numbers several times, is very well illustrated in the following story, which a Western newspaper man has set going the rounds:

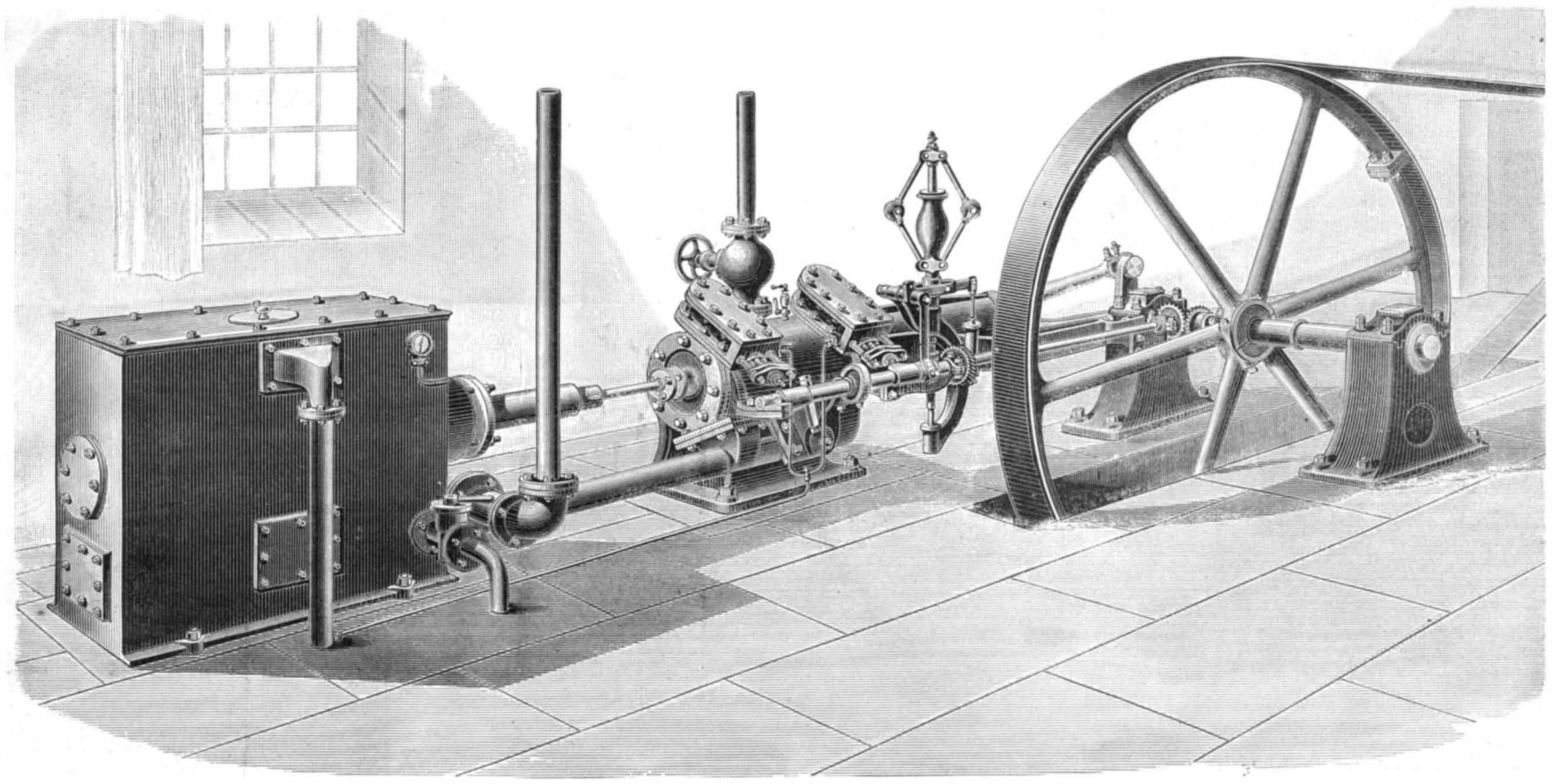
A merchant employed a clerk, who wanted the place principally to learn the business, "salary being no object." At the suggestion of this industrious seeker after knowledge and contemner of worldly goods, the merchant willingly consented to fix the salary at 1 cent for the first month, 2 cents for the second month, 4 cents for the third, 8 cents for the fourth, and so on for three years. Here is the "account," as figured out by the bookkeeper, which we may well believe "staggered" the merchant: First month .01, second month .02, third .04, fourth .08, fifth .16, sixth .32, seventh .64, eighth $1.28, ninth $2.56, tenth $5.12, eleventh $10.24, twelfth $20.48, thirteenth $40.96, fourteenth $81.92, fifteenth $163.84, sixteenth $327.68, seventeenth $655.36, eighteenth $1,310.72, nineteenth $2,621.44, twentieth $5,242.88, twenty-first $10,485.76, twenty-second $20,971.52, twenty-third $41,943.04, twenty-fourth $83,886.08, twenty-fifth $167,772.16, twenty-sixth $335,544.32, twenty-seventh $671,088.64, twenty-eighth $1,342,177.28, twenty-ninth $2,684,354.56, thirtieth $5,368,709.12, thirty-first $10,737,418.24, thirty-second $21,474,836.48, thirty-third $42,949,672.96, thirty-fourth $85,899,345.92, thirty fifth $171,798,691.84, thirty-sixth $343,597,383.68; total salary for three years, $687,194,767.35.

This is, we suppose, a modern companion of the old story where a Hungarian King bankrupted himself by paying (?) a blacksmith for putting in 32 nails in the shoes of a horse at the rate of a penny for the first nail, two for the second, etc., and suggests also the computation which shows that a grain of barley to the first square of a chessboard, two grains to the second square, and so on through the 64 squares, will give a final aggregate exceeding the whole barley crop of the world through an indefinite period. Such facts, however, always strike one with wonder the first time they are brought before the mind.

South Polar Inspection.

Since Wilkes and others found the Antarctic coast line "impenetrable," the U. S. Government should send a vessel provided with a suitable captive balloon outfit, so that if the 1,500 miles or more of inaccessible cliff 3,000 feet high cannot be passed over, it may, at least, be peeped over. From attainable altitudes, aided by telescope and camera views, to be magnified, much that is interesting may be learned. And such a balloon can be easily manipulated so as to safely land passengers and supplies on these cliffs, secure communication, and bring them away when done.

W. L. DAVIS.



MENNIG'S STEAM ENGINE.

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ENGINEERING INVENTIONS.

A mechanism for driving hand cars has been patented by Mr. Ferdinand E. Canda, of New York city. It consists of a series of links united in the form of a lazy tongs, arranged to be extended and contracted to impart rotary movement to a crank shaft, by a double armed hand lever, so that the car may be driven at a high speed by ordinary hand power.

A cattle car has also been patented by the above inventor, which has an arrangement of food bins, feeding sack, and water trough of novel construction, so contrived that the car may be used to carry cattle in one direction, and freight or merchandise on the return trip, the feeding boxes being adapted to fold back out of the way.

A water tank for cattle cars forms the subject of another patent issued to the same inventor, the tank being arranged beneath the flooring of the car and provided with connections whereby it is filled and the water forced therefrom through a nozzle located above the roof of the car, the parts and their connections being so constructed as not to be injured by excessively cold weather.

A railroad tie has been patented by Mr. Thomas A. Davies, of New York city. This invention consists of friction plates to be driven into the tie beneath the bases of the rails, the plates being tapered and arranged, two near each side of the tie, inclined to the grain of the wood, to prevent the ties from being worn by the movement of the rails.

An ore conveyer has been patented by Mr. John Q. Day, of Red Cliff, Col. It consists of an endless wire cable carrying buckets, and arranged to run over grooved wheels, the motion of the cable being caused by the weight of the charged buckets, there being devices whereby the speed is automatically regulated, and the buckets filled and dumped automatically.

A throttle valve has been patented by Mr. James A. Stout, of Belleville, Ill. The valve casing is formed of two parts, one having a discharge passage near the middle of the casing, and the other having valve seats opposite the discharge passages, circular valves being connected in pairs by stems and carried by a forked cross arm secured to a spindle journaled axially in the valve casing, whereby the valves and valve seat will be evenly worn by use to a truebearingsurface.

MISCELLANEOUS INVENTIONS.

A damper attachment has been patented by Mr. Isaac A. Abbot, of Denver, Col. It consists of a hook-shaped spring clamp, made to be easily attached, and to grasp the damper shank, and by frictional contact therewith to hold the damper in any position to which it may be moved.

A saw guide has been patented by Mr. John F. East, of Tanner's Creek, Va. The invention consists in a support holding guide carrier arms, having their guide ends adjusted laterally, making a simple construction of top guides for circular saws, easily adjustable, so the guide may clear the saw teeth.

A cartridge holder has been patented by Mr. Milan S. Barker, of Wellington, Kan. It is composed of a single piece of spring wire bent to form a novel holder or clasp for paper and metal shell cartridges, to be carried about the person, in or on hunting vests or coats and in a belt around the body.

A cotton gin feeder has been patented by Mr. Jesse G. Wiley, of Lockhart, Texas. It consists of a rectangular inclined box with spiked feeding belts, a revolving fan blower at the upper end of the box and a screen at the opposite end and lower side, the device being simply made, taking up little room, and feeding rapidly.

A steering attachment for sleds has been patented by Mr. Orlando A. Thayer, of Paris, Me. Steering bars are pivoted to the forward parts of the runners, and held up by spiral springs, but in such way that by pulling upon a cord the lower part of either bar will be brought into contact with the snow or ice, turning the sled toward that side.

A bureau has been patented by Mr. Theodore J. Palmer, of New York city. This invention combines with a base and swinging case for drawers, representing a bureau, a back frame for a glass, so as to represent a bureau with a glass above it, or by swinging open the bureau part an elongated mirror is presented, to take in the whole figure of a person.

A sewer has been patented by Mr. Chas. Schlimeister, of Brooklyn, N. Y. The sewer pipe has a valve pivoted in it, and a branch pipe formed around such valve, so that the discharge of waste water will not be prevented by a back flow of sewage in the sewer, and the back flow will not rise into the drain pipes and force sewer gas into the air or buildings.

A hopple has been patented by Mr. John T. Stoll, of Sacramento, Cal. It is of that class which consists of leg straps and a connecting chain with a swivel, but the arrangement and form of the loops connecting with the chain is such that they are not liable to bruise or cut the legs of the animal, either when walking or lying down.

A broom holder has been patented by Mr. Jacob J. Hiner, of Harvard, Ill. It consists of a wire bent at its ends to form two eyes in alignment, and looped between its ends to form a circular spring-holding side at each side of the eyes, connected by an integral inclined cross piece, the holder being made of a single piece of wire.

A machine for shrinking hat bodies and other articles has been patented by Mr. James Dunlap, of Boston, Mass. It has a revolving shaft carrying arms on which perforated drums are mounted, revolved by suitable gearing, pipes conducting steam to the drums, the machine having great capacity, being simple in construction, and working rapidly.

A band cutter and feeder for thrashers has been patented by Mr. William Tennison, of Mount Vernon, Ind. It has an endless feed apron and slotted feed table, with vibrating arms for feeding the bundles, and vibrating band cutter, with other novel features, the construction being such that it can be placed at either or both sides of the feed hopper of the thrashing machine.

A physician's buggy case has been patented by Mr. Joseph J. Stevens, of Coalesburg, Mo. This invention consists mainly in the manner of combining two opposite medicine or instrument boxes, and attaching to them a single lid, making a case convenient to carry in a buggy or in the hand, when the medicines and instruments will be easily accessible, and which is waterproof.

A straw burning attachment for stoves has been patented by Mr. Silas C. Purdy, of Atkinson, Neb. It consists of a fire box adapted to the front of an ordinary cook stove, on which a straw or fuel reservoir is adapted to be set when filled, and turned bottom upward, the construction being such that the draught can be readily regulated, while the attachment does not interfere with the ordinary uses of the stove.

A hoisting and lowering apparatus has been patented by Mr. Augustus Ilse, of Evanston, Wyoming Ter. This invention embraces a rectangular frame attached to a heavy base to support the apparatus on the floor of a building inside of a window opening, there being a cross piece carrying a swinging arm or boom hinged to the frame, making a device for hoisting and lowering furniture, goods, etc.

A horseshoe has been patented by Mr. Edwin A. Monroe, of Saratoga Springs, N. Y. It has a continuous calk, and inwardly and forwardly projecting lips at its heel, with upwardly projecting lugs, and other novel features, making a shoe which can be readily put on by an amateur after fitting by an expert, and also one which will not ball or pick up stones, and will give the horse an excellent foothold.

A process of casting car wheels has been patented by Mr. William Wilmington, of Toledo, Ohio. This invention covers an improvement on a former patent of the same inventor, to secure with certainty the melting of ferro-manganese or spiegeleisen before it has entered the mould of a car wheel, thus better attaining the gradual modification of the chill-hardening properties of the cast iron in varying degrees in different parts of the wheel.

A glass beveling machine has been patented by Mr. Thomas F. Gilroy, of New York city. Combined with a grindstone and its carriage, and means for moving the latter back and forth parallel with the axis of the grindstone, is an adjustably pivoted and spring pressed rod for holding the glass plate on the carriage against the grindstone, with other novel features for automatically shifting and pressing the edge of the glass against the stone.

A circular knitting machine has been patented by Messrs. Wm. Pearson, Wm. R. Brown, and HerbertPrice, of Salt Lake City, Utah Ter. This invention provides means for raising the needles when preparing for "ribbing" by means of a semicircular bar inserted in the inner portion of the tube, the bar having notches to raise the proper number of needles at once, and being moved from the outside by handles or hooks, to catch the needles by the shoulders.

A machine for waxing paper has been patented by Mr. Edward G. Sparks, of Brooklyn, N. Y. This invention consists in the novel use of one or two heated blankets charged with wax or paraffine, and so arranged that the web of the paper to be waxed may be drawn beneath or between these blankets, and so waxing the paper that it will not need any subsequent treatment, such as reheating, polishing, or scraping, to remove surplus wax.

Business and Personal.

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If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40. Various other foreign patents may also be obtained. For instructions address Munn & Co., SCIENTIFIC AMERICAN patent agency, 361 Broadway, New York.

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Curtis Pressure Regulator and Steam Trap. See p. 142.

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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.
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Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(1) S. L. M. asks (1) a recipe for making alcohol from acorns. A. Crush the acorns, winnow carefully free from shell and skin, mix about 10 per cent of malt and water, heat to 150° Fah. for a few hours, strain, mix the liquid with 1 per cent yeast, and keep at 63° Fah., until fermentation is complete, and then rectify by several distillations. Personal experience and technical skill are of the highest importance, and no success is possible without them. 2. A recipe for making a snare for insects? A. For nocturnal insects, such as moths and beetles, a lighted lamp; sugar or molasses will attract many. 3. How is hydraulic cement made? A. In various ways. Sometimes by calcining and grinding impure limestones. Sometimes by grinding limestones and clays together and then calcining the mixture. 4. Could a person who has good facilities make a good living out of trout culture? A. Trout culture seems not to be very remunerative at the present day. 5. Who was the first inventor of the cash railway for stores? A. It would require an extensive and costly search to determine who was the first inventor of the invention in question. 6. Why does salt preserve meat? A. It resists the development of bacteria and low forms of life, as do many other metallic salts. 7. Four arc lamps, with a resistance of 6 ohms each, are joined in series 150 feet apart, the first lamp 1,500 feet and the last 1,350 feet from the dynamo. The line wire has a conductivity of 96 per cent that of pure copper. Its resistance must not exceed 8 per cent of that of the lamps. The resistance of a foot of pure copper wire 1 mm. in diameter being 9·94 ohms, what must be the diameter of the line wire? The total length of wire is 1,500+450+1,350= 3,300 feet. The resistance of the four lamps is 24 ohms. Eight per cent of this is 1·92 ohms. A foot of the 96 per cent wire 1 mm. diameter would have a resistance of 9·94÷0·96 ohm=10·35 ohms. With this as standard the line wire should be 133·38 mm. in diameter to give a resistance of 1·92 ohms. 8. What length of No. 0000 pure copper wire will have a resistance of one ohm? A. 19,605·69 feet.

(2) W. N. writes: I am using a mixture of some kind for soldering which is of a milky white color and smells of alcohol. What is it made of? A. Possibly it is a solution of lactic acid in alcohol, with perhaps other ingredients.

(3) E. J. N.—See the word asbestos in Webster. Lead pipe is made by forcing partially congealed molten lead by hydraulic pressure through dies in which a core is inserted.

(4) S. T. W.—The efflorescence on brick walls to which you refer is quite common. It consists, as a rule, of more or less of sulphate of magnesia (Epsom salts), contained either in the bricks or the mortar or in both. Unfortunately there is no cure, although it will often disappear of itself or will only be seen at long intervals. In some cases painting the walls with several coats of good oil color has been found effective. Read a paper on the subject by W. Trautwine, contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 123; also paper on preservation of building material in SCIENTIFIC AMERICAN SUPPLEMENT, No. 526.

(5) E. H. asks how near to New York sulphur springs have ever been discovered. A. While water containing slight traces of sulphur may be found within comparatively few miles of the city, the nearest springs, we believe, which contain a sufficient amount of sulphur (hydrogen sulphide) to make them of any medicinal importance are those at Sharon Springs, in Schoharie County, about 165 miles from New York.

(6) L. M. B. asks: 1. What horse power would a 3 cylinder engine 3×3 inch have at 300 revolutions, 80 pounds pressure? A. A three cylinder engine, 3 inches cylinder and 3 inches stroke, running at 80 pounds, no expansion, and at 300 revolutions, would give nearly 8 horse power. 2. What size wire would be necessary for a dynamo four times the size of the dynamo described in SUPPLEMENT, No. 161? A. Use No. 12 and 14 wire. 3. How many 16 candle power incandescent lamps should it be capable of running? A. About four such lights.

(7) W. H. M. and J. M. ask how and of what material the carbons for electric lights are made. A. Of finely powdered coke or some other form of carbon cemented together with coal tar, pitch, or sugar, and heated to a high heat to decompose the cementing material, and sometimes redipped several times into the tar or other liquid and reheated. This is the general method, but there are numerous variations.

(8) M. T. L. says: I am making an electric motor, like that described in SCIENTIFIC AMERICAN, vol. liv., No. 7, page 102, and I have a spool 2¾ inches between flanges, tube ¾ outside, ½ bore, diameter of flange 1¾. 1. What size wire shall I use to wind, and how many layers? A. Use No. 16–20 wire, winding the spool full. 2. Have I made my flanges too wide? A. Your flanges are a good width. 3. How wide an armature ¾ thick do I want? A. Make your armature about ¾ inch wide. 4. Would a counterweight on rear end help any? What length of stroke? A. Use no counterweight; it would reduce the power; give it ¾ inch stroke. 5. Approximately, how much gravity battery is needed to run it? A. Six to ten cells.

(9) G. E. C. asks: What are the chances for success in the profession of chemistry as a practical chemist? Is it possible for a young man with a good education but unable to take college course in chemistry to become a chemist, and what is necessary to be done? How can one get started, and while learning is it possible to earn a fair living by working at the business? Finally, is it an unhealthy business? A. Chemistry as a profession is quite healthy, but except for the few is rather unremunerative. You will earn little while in the learner's stage. Study at home supplemented by work in the laboratory would answer as an imperfect substitute for a regular course.

(10) W. W. R. asks whether railroads whose motive power is electricity are cheaper than those employing horse power. A. This depends on many factors. Where the dynamos can be worked by natural power, as by tidal or other mills, an electric railroad is the cheaper to run. 2. Also, if there is a description in any of your papers of an electric railroad in operation at Baltimore? A. No, but the New York electric railroad of the same constructor is described in SCIENTIFIC AMERICAN, vol. liii., No. 21.

(11) W. W. C. asks: 1. Will you please explain the construction of an annunciator on a burglar alarm, and how it operates? A. Annunciators are frequently worked by drop shutters, connected individually to the doors or windows of the different apartments. When the connection is made by opening a protected window or door, the shutter drops, and discloses the name of the apartment. 2. What is it that makes annunciators so expensive? A. General expensiveness of manufacture, royalties on patents, and similar causes. 3. Of what use is an induction coil in a circuit? A. In a telephone circuit it substitutes a high tension current for a low tension one, obviates the necessity for heavy batteries and large line wire, and by doing away to this extent with induction effects, makes the line more sensitive and less sluggish.

(12) W. S. H.—All steam launches on navigated waters have to pay a license fee of $5.00, be registered, and have a pilot's and an engineer's license, 50 cents each, which may be to one person. Launches on private waters or on waters having no traffic are free.

(13) H. B. asks how to make a boiler that will heat say about two gallons of water in the quickest time to 212°. A. By making the bottom with deep corrugations, so as to expose a large surface to the fire.

(14) H. A. B.—It is cheaper and more economical to carry steam to the distance of a hundred yards than to transmit power this distance by cable. Felt and protect the pipe thoroughly. The friction of the wire cable with its shafts and carrier wheels is greater than the loss of steam by condensation. Cable is not as good or cheap as shafting for the same power for a distance of 300 feet. The turning of a right angle on a cable need lose no more than 5

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per cent of the power. This can only be ascertained by knowing the amount of friction in the change wheels for a given strain. There are examples in which not 2 per cent is lost.

(15) B. F. T.—High pressure engines exhaust into the air, and realize their power only from boiler pressure and expansion. Low pressure engines add to this about 10 pounds per square inch by creating a partial vacuum in front of the piston. This style of engine is not always available, for want of water in sufficient quantity for condensing the steam. Low pressure adjuncts are not considered economical for small engines. Many condensing engines, also, use very high pressure steam.

(16) D. H. V. asks: 1. Can a complete vacuum be formed, and, if so, what would be the external pressure on vessel containing same? A. Yes; about $14\frac{7}{10}$ pounds. 2. Does the external pressure on the vessel denote the exact weight of the atmosphere? A. Yes; per superficial area. 3. To what height can water be drawn with sufficient suction power? A. Possibly, 33 feet or a little more. Generally, 25 to 26 feet.

(17) J. M. S.—The atmospheric pressure only acts upon surfaces freely exposed to the atmosphere. When other pressures are applied, the atmospheric pressure is not removed, but rather included in the new pressure, so that the atmospheric pressure, being originally in equilibrium, should not be added to the mechanical pressure either within or without a cylinder or boiler. The removal of atmospheric pressure in front of a steam-engine piston is actually effected by a condenser and pump. The effect of atmospheric pressure on the steam side of a piston is absorbed in the indicated steam pressure, and should not be separately expressed. In a vacuum pump there should only be one expression for force caused by the removal of the air.

(18) W. C. B. asks a short practical method of calculating, without the aid of the nautical almanac, the time of high water on any given day at a port whose corrected establishment is known. A. The method for obtaining approximate high water from the table of the "establishment of a port" requires a common almanac for the year, which gives the date of new and full moon. Multiply the average daily variation of the tides (about 53 minutes) by the number of days following the last new or full moon, which reduce to hours and minutes, and add to the "established hour" for a given place, for approximate high water.

(19) J. G. McK. writes: We have boiler and engine capacity to do our work with 30 pounds steam. Is it not economy of fuel to carry a higher pressure, say 80 or 90 pounds? A. On general principles, high steam and equivalent expansion is said to be economical, and with the automatic modern engine a saving of fuel is thus realized. If your engine has a cut-off suited for the change, we recommend it. If of the plain slide valve style, with direct eccentric connection, with governor operating a throttle or governor valve, we advise you to let it alone.

(20) R. K.—The solar mean day is 24 hours. The sidereal day is 23 hrs., 56 m., 4·091 s. in solar mean time, which is the time of revolution to the same star.

(21) L. S. D. asks what to use to polish a new mahogany counter. A. Bees' wax ½ pound, alkanet root ¼ ounce; melt until well colored. Then add linseed oil and spirits of turpentine, of each ½ gill, straining through a piece of coarse muslin.

(22) C. G. desires a remedy to destroy ants. A. Use powdered borax sprinkled around the infested places.

(23) J. L.—Stuttering is a purely nervous difficulty. The vocal muscles are able to do perfect work, but, from deficient innervation the mind cannot command them fully, and the trouble of speech commences, and soon the habit is formed, and generally grows worse and worse. The mind *fears* that the words will fail, and as the result they do fail. If the fear could be removed, the trouble would in large part cease. A cure can be accomplished in no way but by the persistent and determined effort of the sufferer himself. Others can accomplish little for him. If his attention and his *fear* can be removed from the muscles of his throat while speaking, if he can *forget* that any trouble is there, he will soon improve in his power. This is the one line in which his efforts must be made, and with persistent patience it can be successful.

(24) D. E. X. asks a remedy for the "heaves" in a horse. A. Take calcined magnesia, balsam of fir, balsam copaiba, of each 1 ounce, spirits of turpentine 2 ounces, with 1 pint best cider vinegar; give for a dose 1 tablespoonful in the feed, once a day for a week; then every other day for two or three months. Wet the hay and other feed with brine. The horse will cough more at first, but looser and looser till cured.

(25) J. F. asks how wash bluing, such as is put up in small wooden boxes, is made. A. Ultramarine is thoroughly mixed with small quantities of an adhesive substance, such as gum arabic, dextrine, or starch, worked into a thick dough, rolled flat, cut into square blocks, and rolled by hand into balls.

(26) E. J. K. asks if aluminum is prevented from rusting by the formation of a thin scale of aluminum oxide. A. Aluminum may, like many other metals, become protected from further oxidation by the formation of a semi-oxidized film, which may become a hydrate by the moisture of the air. So far as we have observed with a bar as cast, broken, and cut, also as polished, we have not been able to discover oxidation upon the surface in several months' exposure to the air of a room. We are disposed to rank it as one of the precious metals of a higher grade than silver, although, like silver, it has its special affinity.

(27) G. E. B.—Hydrogen gas has the lowest conducting power of the gases; lead the lowest conducting power among the metals; asbestos the lowest conducting power of minerals; and cotton is probably the lowest conductor among vegetables, charcoal being also very low.

(28) E. H. asks how near to New York sulphur springs have ever been discovered. A. While water containing slight traces of sulphur may be found within comparatively few miles of the city, the nearest springs, we believe, which contain a sufficient amount of sulphur (hydrogen sulphide) to make them of any medicinal importance are those at Sharon Springs, in Schoharie County, about 165 miles from New York.

(29) F. S. B. asks for the composition of hydraulic mortar. A. One part of Portland cement to two parts of sand.

(30) T. J. G. asks: 1. Explode a charge of dynamite between two stone slabs of equal weight and strength, lower one on the ground, and both in contact with the charge. Would one suffer more than the other, and which? A. We would expect under ordinary cirmcumstances that both would be so destroyed that there would be little choice between them. 2. Suspend a stone slab and explode a charge of dynamite in contact with under surface, would effect be the same as if exploded on top? A. Substantially the same if the contact was as perfect.

(31) S. V. T. asks for a cement that will mend china, which will not give way under cold water. A. Mix quickly 50 parts of plaster of Paris, 10 of quicklime, and 20 of white of egg, and use immediately.

(32) Sphinx ("L. L. S.," "O. J., Jr.," and "T. L.").—The Grecians usually represented the sphinx as a winged lion with the head and breast of a woman. The great Sphinx of Egypt, however, is a recumbent andro-sphinx, or man-headed lion. It symbolized the mysterious nature of the Deity. The extended fore paws, and the small temple between them, are both constructed of masonry. The main body of the Sphinx is hewn out of a natural eminence in the solid rock. In several places, deficiencies in the natural material have been supplied by a partial stone casing. In our illustration (June 5), the ruins of the temple are partially shown. The sketch, however, was evidently made before the excavations had been carried down sufficiently to expose the paws. It is probable that either the artist or the engraver has represented the masonry as extending further back than it does in reality. The head was originally covered with a cap, and had a full beard, but the greater part of both of these has now fallen away, and the outlines generally are very indistinct.

(33) J. E. C. asks: How much would a composition of gas and air expand in exploding in the proportion of one of gas to ten of air? A. About 4½ times.

(34) W. E. W. asks: Why is it that hydrogen is any more diffusive than oxygen or any other diatomic element? Why is it that a hydrogen molecule can crawl between the intervening spaces between the molecules of an iron cylinder, in attempts to liquefy it, any more easily than an oxygen molecule? A. The lighter gases are more diffusive because their molecules, being lighter, move in the kinetic motions with higher velocity, and hence travel faster. As for hydrogen "crawling" through the pores in an iron vessel, if it does this any more readily than other gases, it is on account of its high diffusive power.

(35) H. A. M. says: A has an orange tree which gives a sour flavored orange. To sweeten the fruit he makes a hole in the tree and fills it with as much sugar as he can stow in. This he asserts has the effect desired. B says it will not sweeten the fruit even to a small extent. Please say which is correct. A. We side strongly with B. Why do you not try it?

(36) G. F. H. asks: Will you please inform me if silkworms in cocoons can be killed by electricity, and how it is done? A. We know of no way of killing silkworms in cocoons by electricity. We are informed also by the U. S. Department of Agriculture that they know of no method.

(37) J. B. asks: Is the stroke of an engine the length of cylinder? If not, how is the stroke measured? What is relative horse power of two engines: 1st cylinder 10 inches, 3 feet stroke, 2d cylinder 12 inches, 2 feet stroke. A. The stroke of the engine is twice the length of the crank, center of pin to center of shaft, or the distance of the crosshead movement on the slides multiplied by two. The 10 inches by 3 feet cylinder in power has the relation to the other cylinder mentioned as 235·62 to 226·18. These numbers are obtained by multiplying the areas of each cylinder by its stroke.

(38) Dr. H. S.—Warts may be burned off by application of nitrate of silver or other caustic, but we know of no special treatment to prevent their recurrence. We have printed numerous remedies for the removal of corns, but as they will go away of themselves if one wears only shoes that do not press on them, so they will constantly return, no matter how many times removed, if one wears tight shoes.

(39) H. J. P.—Vacuum gauges do not indicate pounds, but correspond with the barometer, and indicate inches of mercury. Dividing the indication in inches by two will give you nearly the vacuum in pounds.

(40) E. S. asks directions by which considerable adulterations of white lead and linseed oil may be detected by one not a chemist. A. To detect barytes in white lead, dissolve the latter in dilute nitric acid. Any undissolved residue will be foreign material, and probably barytes.

(41) A. B. asks why infusorial earth is called electro-silicon. Is it a non-conductor of electricity or a non-conductor of heat? What is it composed of? A. It is diatomaceous silica, from which the trade name "electro silicon" has been derived. It has no particular electrical qualities.

(42) Mrs. J. B. F.—The insects which you send are a species of plant louse of the genus *Lachnus*. They prove injurious to evergreens when they occur in large numbers. To completely destroy them, it is only necessary to drench them well with a solution of whale oil soap or tobacco water. Another remedy is hot water a few degrees below the boiling point, which will not injure the tree, but will effectually destroy the pest.

(43) O. W. M. desires a recipe for making a stain to imitate cherry or cherry stain. A. A cherry stain may be made by boiling in a copper kettle 3 quarts of rain water, and 4 ounces of annatto. Boil till the annotto is dissolved, then put in a piece of potash the size of a walnut; keep it on the fire about half an hour longer, and it is ready to bottle for use.

(44) G. A. G. asks how to destroy ants that infest his lawn. A. If the nests of the ants can be readily found, there is no better remedy than to pour a tablespoonful of bisulphide of carbon into each hill. This substance is inflammable, and should be used with care.

(45) W. A. writes: I have noticed in your issue of the SCIENTIFIC AMERICAN, at various times, the receipt for making a printing machine called the hektograph. You also gave a recipe for making a black ink to be used with the same. I have tried both, but I find a great difficulty in gaining a success. I have tried the process for the ink in the manner you describe, but I fail to produce any copies. Ink is prepared with nigrosine. It will not create a bronze. Would you therefore kindly direct me in the right direction, that is to say, to get a black ink, that can be used by the hektograph? A. The ink you desire is made by dissolving soluble nigrosine (aniline black) in 5 to 7 parts of water. It should be a saturated solution and rather thick. For use on the hektograph it is best to use a purple ink. See "The Copying Pad, etc.," contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 438.

(46) W. C. B.—To make stereotypers' paste: Take 5 ounces of flour, 7 ounces of white starch, a large tablespoonful of powdered alum, and four quarts of water. Put the flour, starch, and alum into a saucepan, and mix with a little of the water, cold, until the whole becomes of the consistency of thick cream. Then gradually add the remainder of the water, which must boiling, stirring well meanwhile to prevent lumps. Put the mixture over the fire and stir until it boils; then let it stand until quite cold, when it should look like jelly. When you are ready for work, add Spanish whiting, the mixture not to be too stiff to spread readily with the paste brush. Put through a fine wire sieve with a stiff brush, and it is ready for use.

(47) W. F. C.—Black, glossy leather belts, made of japanned leather, can be improved in appearance by rubbing with linseed oil, but there is no suitable permanent blacking for them that also keeps their polish. There is no cure for their cracking as they get old, or from rough usage.

(48) G. H. L.—The fluid extract of sarsaparilla is made by exhausting the powdered root with alcohol. Sarsaparilla sirup used in soda fountains is made of oil of wintergreen 10 drops, oil of anise 10 drops, oil of sassafras 10 drops, fluid extract of sarsaparilla 2 ounces, simple sirup 5 parts, powdered extract of licorice 1 ounce. Sarsaparilla beer is made by dissolving 1½ ounces compound extract of sarsaparilla, with 1 pint of hot water, when cold, add of good pale or East India ale, 7 pints.

(49) N. P.—Ox gall is an excellent and delicate cleansing agent. It is a liquid soda soap. But a receipt said to be excellent for removing all such substances as tar, axle grease, etc., from colored cottons: First, smear with lard, rub with soap and water, and let it stand for a short time; then wash with oil of turpentine and water, alternately.

(50) R. I. M.—For a good paste that will neither decay nor become mouldy, mix clean flour with cold water into a paste well blended, then add boiling water, stirring well up until it is of a consistency that can be easily and smoothly spread with a brush; add to this a spoonful or two of brown sugar, a little corrosive sublimate, and about half a dozen drops of oil of lavender or other suitable perfume.

(51) A. W. L. writes: 1. A gentleman who has been lecturing here says that but very little rain has fallen in Palestine for 1,200 years, and that now (within 5 or 6 years) it is receiving copious rains and becoming fruitful. Is this a fact, and, if so, what is the cause? A. By consulting the Encyclopedia Britannica, you will find full information in regard to the rainfall of Palestine. The average rainfall is 60 inches, which exceeds that of many portions of this country. 2. What is the receipt for a so-called white house paint made of skimmed milk and lime or whiting? A. Take of whiting 5 pounds, skimmed milk 2 quarts, fresh slaked lime 2 ounces.

(52) E. A. M. D. asks the greatest height known of a wave of water in mid-ocean and near land, during a storm. A. According to Scoresby, the greatest height of waves from storms observed by him was 43 feet from top to bottom of trough. Captain Wilkes, while on his exploring expedition in the Pacific, made one measurement and obtained only 32 feet.

(53) J. T. McC. asks how oil can be taken out of a marble tombstone; has been in it now about four years. A. Such stains can be removed by applying common clay saturated with benzine. If the grease has remained long enough, it will have become acidulated and may injure the polish, but the stain will be removed.

(54) J. N. W. asks how the composition used for whitening military belts is made. A. First brush the belt over with a mixture of:

Best boiled linseed oil..... ... .4 oz.
Precipitated oxide of zinc.....1 "

And dry over a stove at a heat not over 160° Fah. When thoroughly dry, roughen by means of pumice powder and apply another coating. Dry as before, and varnish with amber or copal varnish.

(55) E. D. asks how to gild the edges of cards in gold and silver. A. Obtain an extremely thin leaf of gold. Put your cards together so that the edges are perfectly even. Then place in a press, with the exposed edge uppermost. Coat the edge with a mixture of red chalk and water. The gold is blown out from small books, and spread on a leather cushion, where it is cut to the proper size by a smooth edged knife. A camel's hair pencil is dipped into white of egg mixed with water, and with this the partially dry edge is moistened; the gold is then taken up on a tip brush and applied to the moistened edge, to which it instantly adheres. When all the four edges have been gilt in this way, and allowed to remain a very few minutes, take a burnisher formed of a very smooth piece of hard stone (usually bloodstone), and rub the gold very forcibly, which gives the gold a high degree of polish. To silver edges take a brush, dip it in a saturated solution of gallic acid, and wash the edges; then dip the brush into a solution composed of 20 parts nitrate of silver to 1,000 parts distilled water. Keep on alternating these solutions until the edges assume a brilliant tint. Then wash with distilled water, and dry by free air and heat.

(56) G. Z. asks: 1. Would you kindly give me a good and simple method for purifying the gas called carbonic anhydride (CO_2), chemically expressed? A. Wash it with a little water already saturated with gas. 2. Also a formula for making fireproof wood having a black appearance. A. Wood is made fireproof by treatment with various metallic salts, as tungstate of soda or silicate of soda. It is blackened by treatment first with nitrate of iron in solution, followed by solution of logwood.

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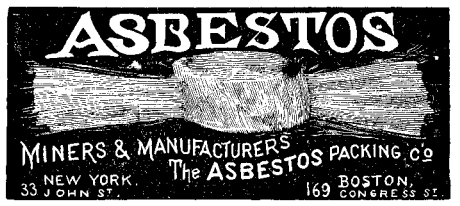
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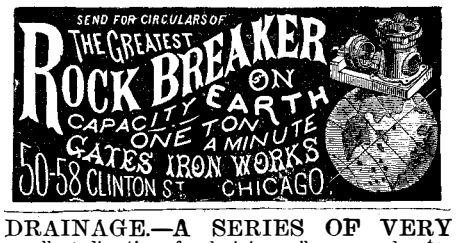

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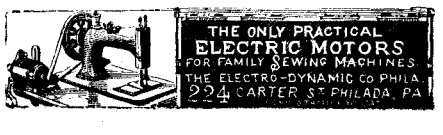

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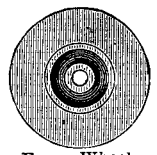

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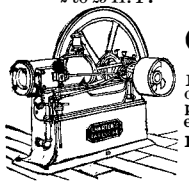

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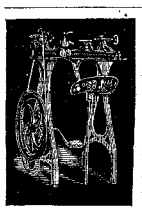

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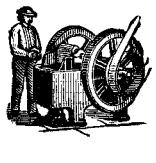

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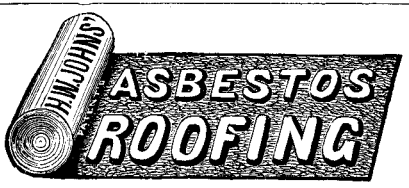

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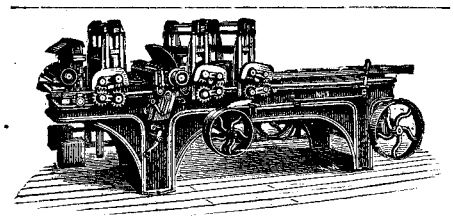

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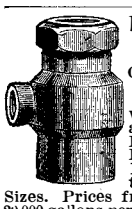

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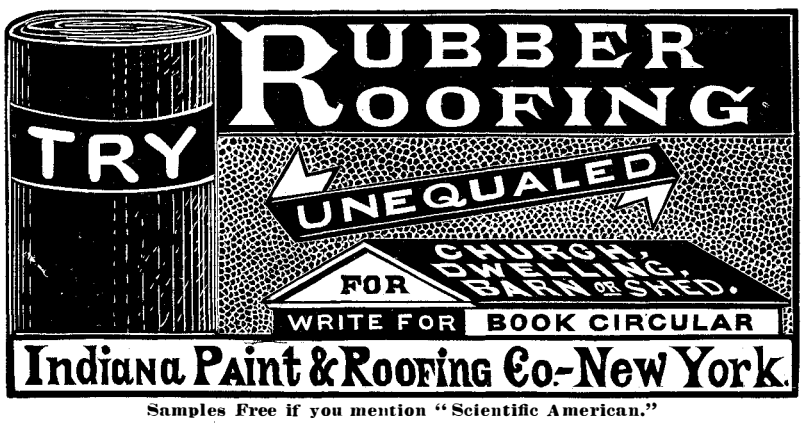

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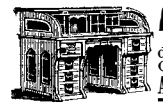

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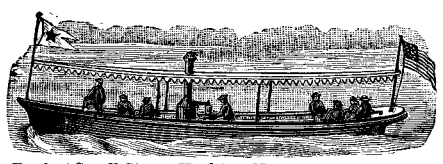

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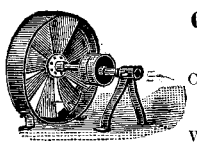

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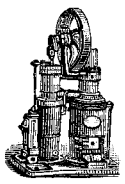

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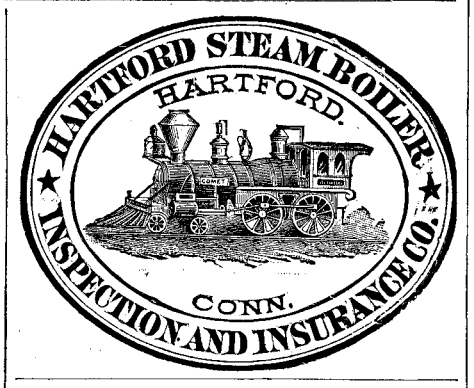

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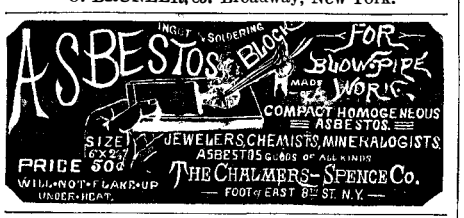

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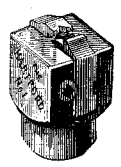

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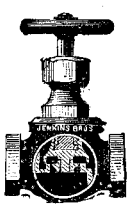

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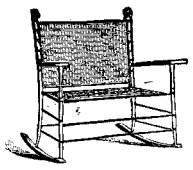

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